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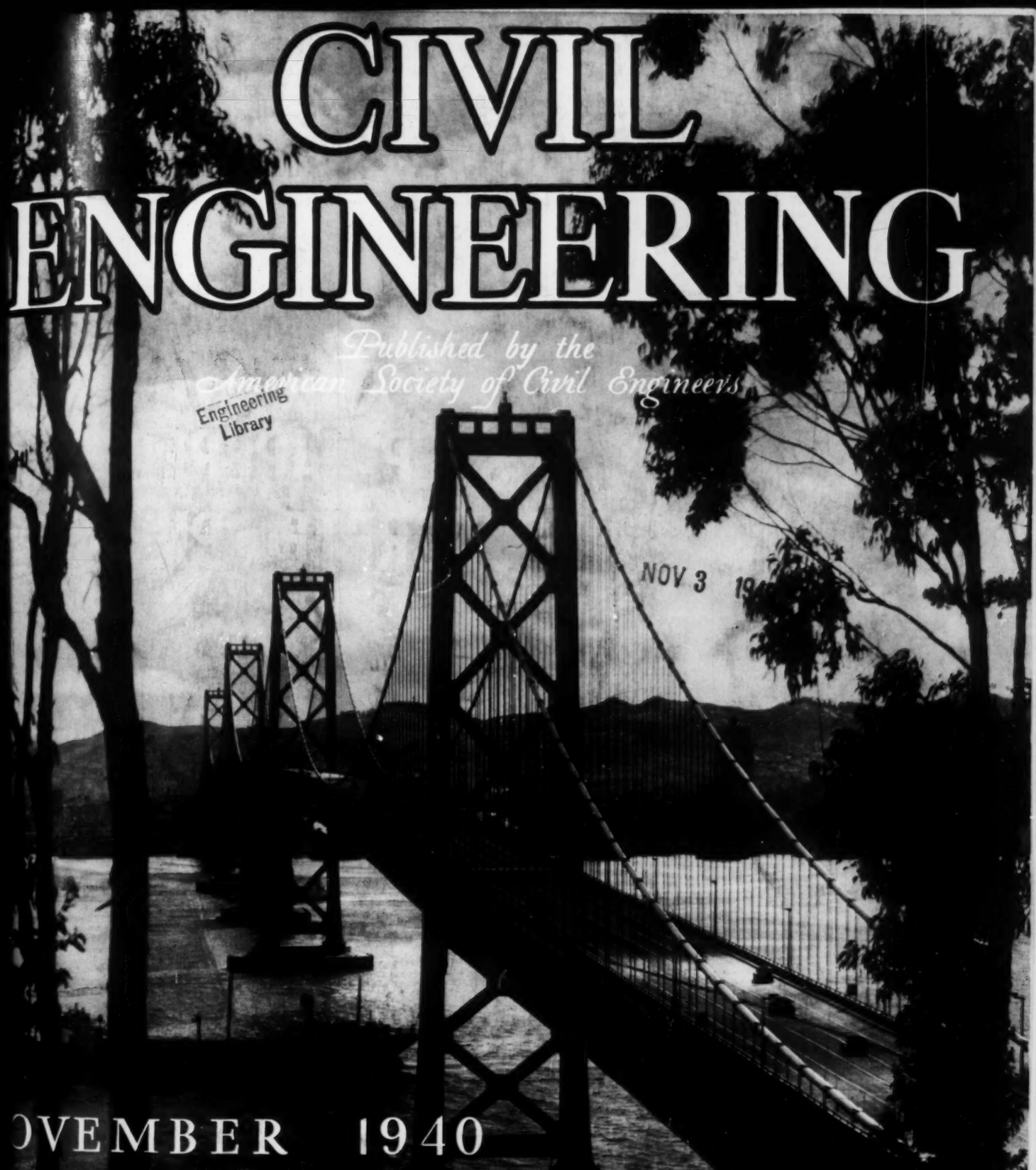

OVEMBER 1940

AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852

Volume 10
Number 11

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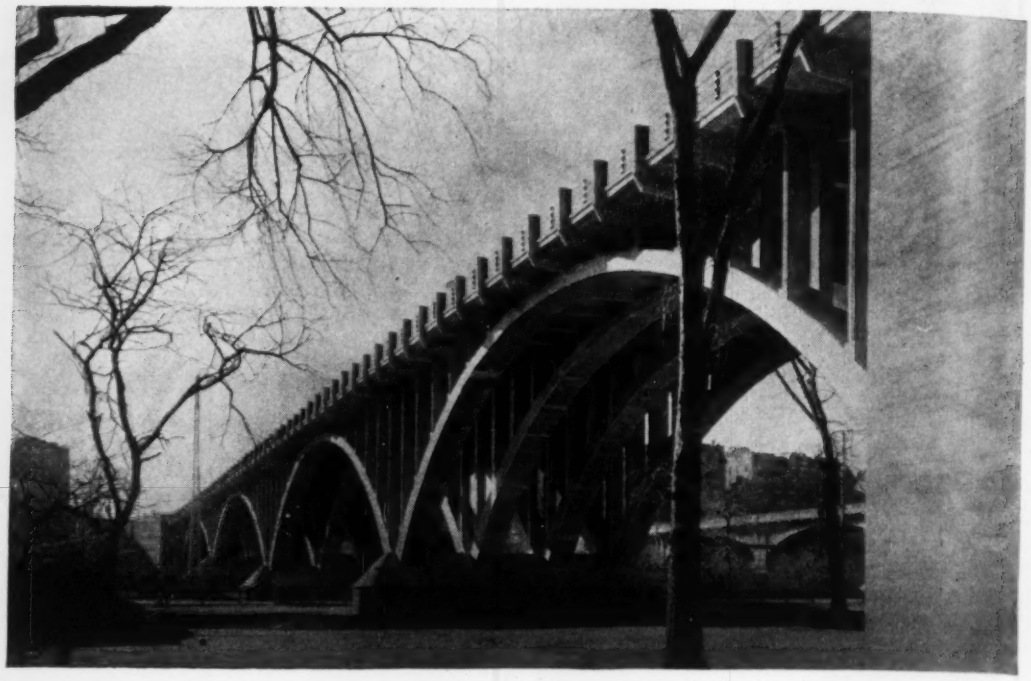

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Something to Think About

A Series of Reflective Comments Sponsored by the Committee on Publications

Opportunities in Making Ends Meet on the Small Project

By Robert M. Lingo

Junior, American Society of Civil Engineers
Chief Engineer, Municipal Power and Light Plant, Casey, Ill.

IT seems that all engineers are interested in finding some way for the young graduate to get in his days as a "journeyman," following his "apprentice" work in college, before he becomes a full-fledged "master craftsman." In four years of such work I have been on nine different payrolls. Although never without work, I have spent many sleepless nights wondering where the next move would land me. No doubt, like all young engineers, I have formed some very definite opinions about these problems and their solutions.

In my work, which has been in the Missouri River valley, labor unions and labor organizations have been unknown, except for the WPA. This sort of work is definitely of the "small project" type, but even so it involves lots of engineering.

Various Abilities on Call.—A small job does not justify a sufficient engineering fee so that the consultant can afford to hire men of wide experience. He therefore turns to young college graduates. A job of this type was the sewer project for which only $150 to $175 a month was budgeted for the field engineer. Considerable was expected of him, however.

On my first contract job I soon learned that there were no sewers in the town and the project was to supply service to every house, lay an outfall to a point two miles away, and there build a disposal plant—cost of sewer about $55,000, and that of plant, $25,000. Like many federal-aid projects in the last few years, the plans were produced hurriedly; specifications were loose and sometimes lacking.

On another job, for 30,000 ft of sewer and a complete pumping station and disposal plant, my entire instructions consisted of three sheets of drawings, with no specifications. My first duty was to inspect all materials to be furnished by the contractor and to say whether or not they would satisfy the specifications—or needs. Well, back at college, we might have utilized a well-equipped laboratory; in the field things were a little different. Finally I found a meat merchant who happened not to be using his scales. Accurate? Well, maybe! Here were sand, cement, brick, clay pipe, cast-iron pipe, jute, electrical equipment, reinforcing bars, and structural steel. How was a young engineer to know the proper test for each item that, for example, might have "to meet the specifications of A.S.T.M."? Now all I had to do was find those standards. But the contractor was ready to go to work tomorrow, so I had to inspect materials now.

Practical if Not Theoretical.—Then came the business of mixing concrete. The language of the construction game was entirely different from that used at college. It is difficult to tell an old-time concrete man that "six shovels of sand and two of cement" is not a very accurate measurement. I found out that good concrete, even if not technically correct, is the kind that falls from a mixer and breaks at the proper point in the chute—or "plops" just right as it lands. Sometimes, rather than try to compute the exact ratio, the contractor will put in one more sack of cement and go ahead.

Again, data on a 20-yd bucket and a 5,000-ft conveyor were useless when it came to handling a wheelbarrow, "bridge-plank," jin-poles, or good old block-and-tackle. Mechanical vibrators are fine; but when is a concrete wall properly placed by hand and when is it necessary to put more men to work "spudding" it? No technical work here, yet the "inspector" has to take the blame if the concrete fails, since he was there when the work was done.

Practice in Diplomacy.—After such a practical introduction to the construction business, I was needed on the sewer end of the job. I took out the trusty transit and began locating sewers just as nice as could be. Then about noon appeared a woman with an ultimatum, "You can't cut up my garden." Now engineers with their million-dollar jobs probably would laugh at her, but I was at a complete loss. Here was Sarah Jones, a sister of one of the councilmen, who wanted her yard left just as it was. My plans said to go through there, and the

contractor wanted to get started. So I switched to the other side of the alley, only to be faced with another irate woman.

Finally I decided to get some official action; I went to the city council to ask for the necessary authority to proceed, and found—no city attorney. It seems the city hired a consulting engineer to put in this sewer and the consultant hired me to do it; so as engineer—or "goat"—I now had to forget construction, surveying, and concrete, and spend some time by lamplight trying to draw up legal papers for a right of way. I could have gone to a lawyer but that would cost money, and we did not have it to spend. On investigating the situation, I learned that the record, drawn up and signed, had to be recorded at a distant county courthouse. Meanwhile the concrete went merrily into place without an inspector.

While I was in the courthouse I found out from the county surveyor that there had been, way back in the dim past, a survey made of the town I was tearing up. Here in his office was a record of some property lines. Wonderful; but this little town had not developed as it started out, and the street lines were only 40 or 50 ft off! I found there had been a long quarrel between two owners over a property line. When my sewer came through they asked me to settle the dispute. The county surveyor, a born diplomat, had always "played possum" on that situation. Rather than get mixed up myself, I secured an easement from both property owners and went through—on whose property, I never knew.

Finances Involve Ethics.—Now that about 5 per cent of the work was completed the city expected me to foretell how the cost was coming out. Here is one of the hardest parts of such a job—working with elected officials who may be intelligent doctors, storekeepers, and retired farmers, yet have to be instructed in engineering to make them understand what is necessary.

Estimates were expected of me. I learned that one of the ways of letting a contractor get a little working capital is by allowing a rather large percentage of the work at first. To the council meetings come the salesmen who have lost their contracts and want to know why. Others approach the engineer offering various personal effects if he will specify their materials.

Naturally, changes must be made in the plans as the work proceeds, but an engineer should be able to make them easily and with an air of assurance. In my first case I ran into some mysterious trouble. For some unknown reason, the city had taken the plans to another engineer, who recommended changes. I was asked to alter my employer's plans. When my answer was "No" I was subjected to letters saying that I had failed to "cooperate" with city officials. Miserable ethics, to be sure; but an engineer runs into such conditions and must fight back against influential business men—"big shots," who although ignorant of engineering, hold the purse strings.

Wanted—a Man of All Trades.—As engineer, I have been appointed a committee of one to draw up a city ordinance. On several occasions the mayor has asked me to condemn workmanship so that certain men could be fired, for the reason, I found, that they had failed to pay their bills about town and the merchants had put pressure on the mayor. In other cases workmen complained because they were underpaid. Since I was the inspector I was supposed to look into this matter too.

Such is the mass of divergent duties a young engineer is called upon to perform on smaller works. Some claim that the smaller jobs do not require the attention to details and exacting requirements as to materials, location, and workmanship. But who can say where the dividing line is? Why not put engineering detail and workmanship into practice on all jobs, large and small?

Ability at a Premium.—Apparently there is a real opening for the profession, not in the highly technical field, but in the mass of small works. And there is real opportunity here. True, one has to look for a new job almost every six months, but there always seems to be one, somewhere, and each offers good experience.

If engineers realize the multitude of jobs they are able to do better than other trained men, and will use their training in the field of small projects, they can find work. However, colleges seem to train engineers for highly technical jobs, and forget the proper teaching to fit this technical knowledge into average small-town conditions.

Whether such training is the responsibility of the engineer, the school, the consultant, or society, it is hard to say. But somewhere, somehow, the young engineer must learn the ways of the world and how to get along with non-technical men. He must learn what is in the local blacksmith shop, lumberyard, county surveyor's office, and know something of track jacks, picks and shovels, slings, rope, and plank. How to handle unskilled labor is one definite job schools do not teach.

We hear that engineers should read a good periodical. Fort Peck, Grand Coulee Dam, and all such projects are wonders and deserve the mass of material that has been written about them, but what about an article telling how much a crew of five men with shovels and picks can do in one day? On one job needing shoring, we had to go 20 ft below water, in sandy soil. All the periodicals gave excellent articles on sheet steel piling, but we had only $3,000 to spend for the entire structure—labor, shoring, digging, and all. And there was no article dealing with a problem like that.

Many, if Not Large Opportunities.—I fully believe that if the engineering profession will train men, in some way, to accept and hold positions where there are not millions but thousands, and perhaps merely only hundreds of dollars to be spend, the profession will be able to handle the mass of idle engineers, because there will be many new, if not spectacular, jobs. Every town needs—and wants—its own map, a water-main map, an electrical-distribution map, and records of all utility operations. Many towns of 5,000 population would like to have a technically trained man on their payroll. Engineers are actually needed to discover what facilities a town really has and to help clean it up. Rather than "engineer" they may be given some such title as "sewer superintendent." But whatever the title, the work will be true engineering and will pay a salary.

The young engineer must be able to do a variety of things, not perfectly—in the eyes of technical men—but practically and expeditiously, with the means and methods at hand. How can he learn to do such engineering work? Possibly a course in "Human Relations" is the answer. At least if the engineer will come down off his technical high-horse and learn to apply his abilities to the problem of handling men, he will find plenty of work—and success.

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Fitting Rolled Earth Dams to Local Materials

Recognition of Functional Possibilities of Nearby Quantities May Permit Economies of Haul or Yardage and May Improve Stability

By B. K. HOUGH, JR.
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IN building rolled earth dams, full advantage may well be taken of the behavior of seepage by utilizing the section above the saturated zone to absorb random materials. Together with a contraction of the classified sections, this reduces the field control problem as well as the hazard of shortages. Introduction of interior drainage also promises to be effective in reducing wave damage. Mr. Hough's views were presented before the Soil Mechanics and Foundations Division at the Society's Denver Convention.

THE degree of success attained in an earth dam design may be gaged by the extent to which it is functionally correct and adapted to the most effective use of available materials. Exploration of such materials may be undertaken in accordance with any one of several different procedures.

According to one of these the designer starts out with a fairly definite idea as to the general nature of his final design and conducts his field investigations and prepares his plans and specifications with the object of adapting existing conditions to the preconceived plan. This sometimes results from using, as the basis for final design, preliminary plans prepared for cost estimates in advance of subsurface exploration. This leads not only to restricting the search to given types of materials, but to continuing explorations until the specified quantities of each type are located.

Another method, stepchild of the first, involves the investigation of materials in the vicinity of a proposed site for the purpose of locating those that are "suitable for earth dam construction." This implies acceptance of the theory that there is some fairly well-defined standard for judging the suitability of earthen materials. Such a theory conflicts with the belief that earth dams if suitably designed may be built of almost any material not soluble in water. Reflection on this conflict leads to the conclusion that the only genuine standard for suitability of materials is the design itself. Probably those who subscribe to the theory that materials may be classed as suitable or unsuitable actually have the outlines of some design in mind when undertaking the initial soil survey.

Exploration for either of the methods described may become extremely uneconomical. The borrow pits finally selected often lie at unnecessarily great distances from the site. Drill holes and test pits encountering unwanted materials may be abandoned at shallow depths only to be reopened or duplicated when plans are changed. On such projects as the construction of large levee systems, a particularly unfortunate result is that the conflict between the "theoretical" considerations related to material selection and the practical necessity for using immediately available materials has sometimes led to rejection of all forms of scientific analysis of design. That scientific analysis need not be incompatible with practical considerations is the thesis of this paper.

Having had experience with both of the practices mentioned, the writer favors a third policy—that of exploring the materials closest to a given site with the sole purpose of accurately classifying them with respect to their geological and physical nature and extent and without any preconceived ideas whatever as to their ultimate utilization. Only on completion of such a survey should the first outlines of the final design be formulated.

In developing the final design, plans for distributing the available materials within the embankment section will be made. These should take into account the

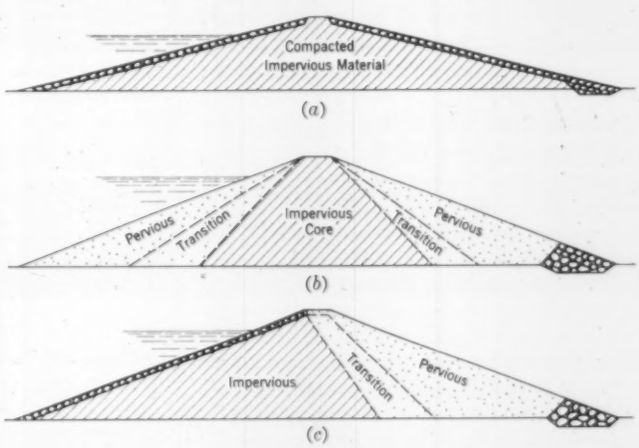


FIG. 1. CONVENTIONAL DESIGNS FALL INTO THREE CATEGORIES
(*a*) "Homogeneous Type" Used When a Single Impervious Material Is Available, Has Flat Slopes Suitable to Weak Foundations; (*b*) "Standard Type" Utilizes Selected Sections to Achieve Drained Slopes and Economy of Yardage; (*c*) "Storage Type," Available When Rapid Drawdown Is Not a Factor, Requires No Permeable Upstream Shell

nature of the development, that is, whether storage for long periods with gradual drawdown is contemplated or only brief storage with rapid fluctuations in reservoir level. These considerations are essential criteria of design, a complete statement of which is fully as essential to rational design as is complete and unbiased classification of the materials available for construction. In many cases, however, statements of criteria degenerate into generalities such as "a dam must be safe against overtopping" or "against free passage of water from upstream to downstream face." These are so vague that undiscriminating adherence to precedent and custom may become the actual basis of design.

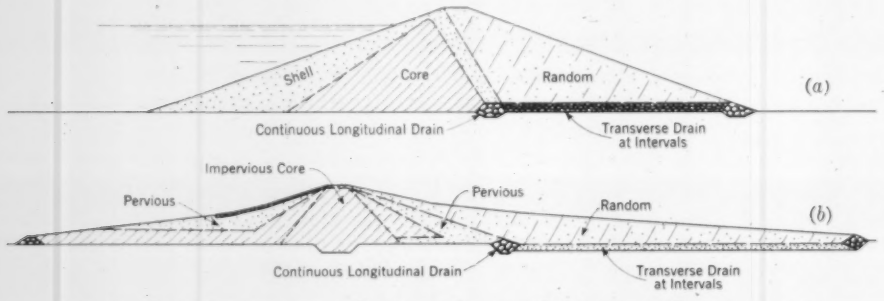


FIG. 2. INTRODUCTION OF A RANDOM SECTION MAKES FOR FLEXIBILITY IN MATERIAL SELECTION

Interior Drainage Section Intercepts and Withholds Seepage from Downstream Face. (*a*) Proposed Section; (*b*) The Whitney Point Dam, New York

Control of seepage may be taken as an illustration of the importance of exact definition of design requirements. It is axiomatic that a dam must be capable of reducing stream flow, sometimes to negligible amounts. This idea originally dominated dam design to such an extent that costly sheet-pile and concrete cutoff walls both in embankment and foundation were considered necessary. Only the most impervious clay materials were considered suitable for cores. Gradually opinion on this subject is changing to the view that unless water storage is a prime requirement, the quantity of seepage is not as important as is its safe conduct from the embankment by adequate drainage systems. The new policy cannot be put to intelligent use, however, unless some figure is quoted as to the maximum seepage that will be permitted, for the proportions of the core and the capacity of the drains logically should be based on such a figure. The preparation of suitable criteria (a subject deserving full treatment by itself) should be the responsibility of the highest authority rather than of the designer or the construction engineer. Once established, basic criteria should be adhered to throughout the job instead of being subject to change when unexpected conditions are encountered.

With a complete classification of available materials and a comprehensive set of criteria before him, the designer's job becomes one of choosing the most economical section that will utilize these materials effectively. In this there is great opportunity for the display of ingenuity and engineering ability. Reliance upon precedent and tradition alone may result in an uneconomical (sometimes an unsafe) design, since problems of this type cannot very well be standardized. Restriction of choice of design to one of the relatively few conventional types of embankment section results in increasing rather than decreasing the difficulty of arriving at a satisfactory solution, for it imposes an additional, arbitrary criterion.

The most elementary of the conventional types is the so-called homogeneous embankment shown in Fig. 1 (*a*). The Wappapello Dam on the St. Francis River, Missouri, is of this type. As the name implies, this section is constructed of but one type of material, usually impervious. It is obviously most suitable for use in locations where no variation in natural deposits exists. It is also suitable for many levees, as the small size of the usual levee often makes the use of a variety of materials unjustifiable even when they are available.

A more elaborate but a more efficient design results when both pervious and impervious materials are used. Conventional practice in such cases utilizes the impervious material in a central, triangular core section flanked on each side by pervious shell sections. Most hydraulic-fill dams necessarily conform to this pattern and its use for rolled-fill dams has been so general in recent years that the writer proposes to refer to the type as "standard" (Fig. 1, *b*). In the Muskingum River Flood Control Project several rolled-fill dams, notably the Mohawk Dam, were built on this principle.

"STANDARD" DESIGN MODIFIED FOR SLOW DRAWDOWN

Dams so constructed possess greater stability with respect to seepage forces and the effects of reservoir drawdown than do homogeneous dams having the same side slopes. When rapid reservoir drawdown is not a factor, the standard dam may be modified to the special type shown in Fig. 1 (*c*). In this the pervious material in the upstream section is replaced with impervious to afford maximum effectiveness in reducing seepage. The pervious downstream shell is retained to secure stability against seepage forces at exit. This might be termed the storage type since it is most suitable, available materials permitting, for a dam intended primarily for water storage at reasonably constant reservoir level. The Great Salt Plains Dam on the Salt Fork of the Arkansas River, Oklahoma, is an example.

Of the foregoing three types, the homogeneous would

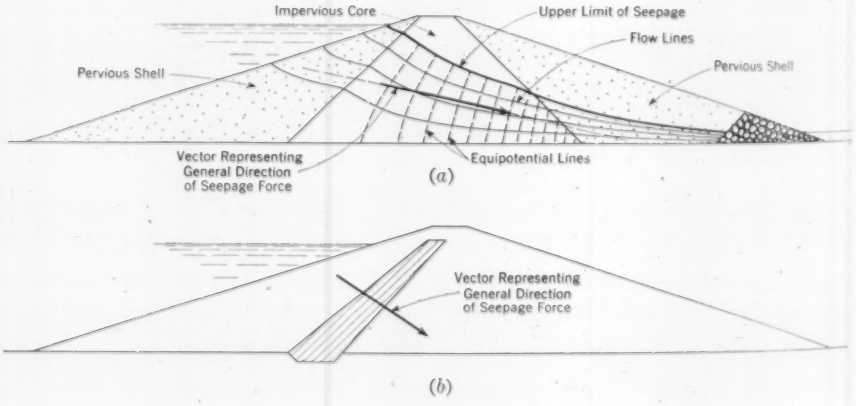


FIG. 3. INCLINED CORE IMPROVES SEEPAGE FORCE VECTOR

(*a*) Flow Net and Seepage Force Vector with "Standard" Section; (*b*) Vector Steepened with Inclined Core

be the most suitable where foundations are bad, since the relatively flat slopes required to resist drawdown forces would contribute to foundation stability. Where foundation conditions are good, if coordination of embankment with a concrete power house and retaining wall are desired, the steeper slopes permitted by the standard dam of Fig. 1 (*b*) would be preferable even though a long haul for select embankment materials might be required.

It is the writer's contention that the three conventional sections described are not sufficiently diverse to meet all ordinary combinations of conditions with maximum efficiency. General realization that an almost infinite number of designs can be used might improve this situation. The practice of selecting materials on the basis of their suitability for earth dam construction should be abandoned in favor of selecting dam designs on the basis of their suitability for construction with the nearest available materials.

A difficulty with the former method lies in the fact that every cubic yard of material placed within each section must be chosen to conform to adopted standards. Unless well-defined separate deposits of each class of material are available, continuous careful selection either by visual inspection or through extensive field laboratory tests must be maintained. Even soil specialists should be interested in reducing the amount of this type of field control, for it is a source of both expense and annoyance. In addition it may result in wasting certain materials that would be usable under more flexible standards.

Intimately connected with the requirement that all materials be selected is the hazard of unexpected shortages. When these occur, search must be conducted in more distant areas; often uneconomical "teaspoon" operations must be conducted; or (last but not least) the design or standards of material selection must be changed. The first two procedures almost invariably involve additional expense, while the last casts an embarrassing doubt on the competency of the original design. It is difficult to explain to an organization why construction standards or basic design can be radically changed to meet field conditions when their fundamental importance has previously been emphasized.

RANDOM SECTION ADDS SAFETY AGAINST SHORTAGE

This difficulty may be expressed in the statement that conventional dams usually have no factor of safety against material shortages. Considerable progress can be made toward overcoming this difficulty if the dimensions of select sections are decreased to those actually necessary for proper functioning under competent criteria. If this is done it will generally be possible to provide the embankment with a random section. The cost of inspection of materials will be reduced and insurance against unexpected shortage of materials will be gained in almost direct proportion to the relative size of this random section. An example of the introduction of a random section is given in Fig. 2 (*a*). It should be emphasized that the designation "random" does not require an additional set of standards or create another class of material (except perhaps as a pay item). "Random," in this usage, means simply "unselected," and the material may have any character from pervious to impervious, provided, of course, that sufficient compaction for stability can be obtained.

An illustration of a dam with a random section over the downstream drainage system in a manner roughly approximating the proposal presented graphically in Fig. 2 (*a*) is the Whitney Point Dam, New York, shown in Fig. 2 (*b*). This dam is now under construction by the Binghamton District Office of the U.S. Engineer Department.

In Fig. 3 (*a*) a flow net is superimposed on an entirely conventional, standard section. The possibility of reducing the dimensions of the select pervious section in the downstream shell is apparent almost at first glance since it is evident that approximately the upper two-thirds of the shell is ineffective for drainage purposes. This situation is familiar to most engineers, yet in actual practice the habit persists of using the same care in selecting materials for topping out shell sections as is exercised at the bottom.

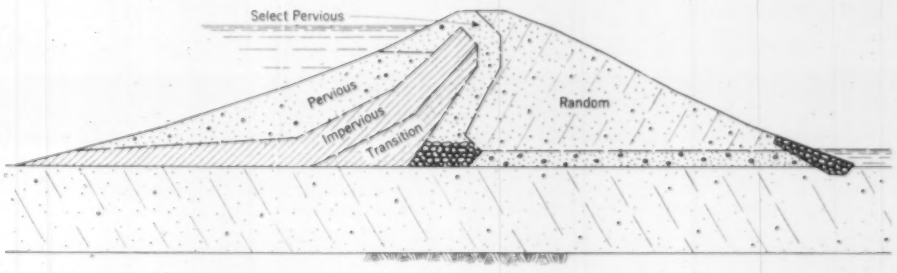


FIG. 4. A DESIGN EMPLOYING MINIMUM PROPORTIONS OF GRADED MATERIALS

Further examination of Fig. 3 (*a*) indicates that the section of the impervious core above the top flow line also is ineffective for its intended purpose, namely, reducing seepage. Where impervious materials are scarce, some saving could be effected here. In Fig. 2 (*a*) the upper section of the core is narrowed for this reason.

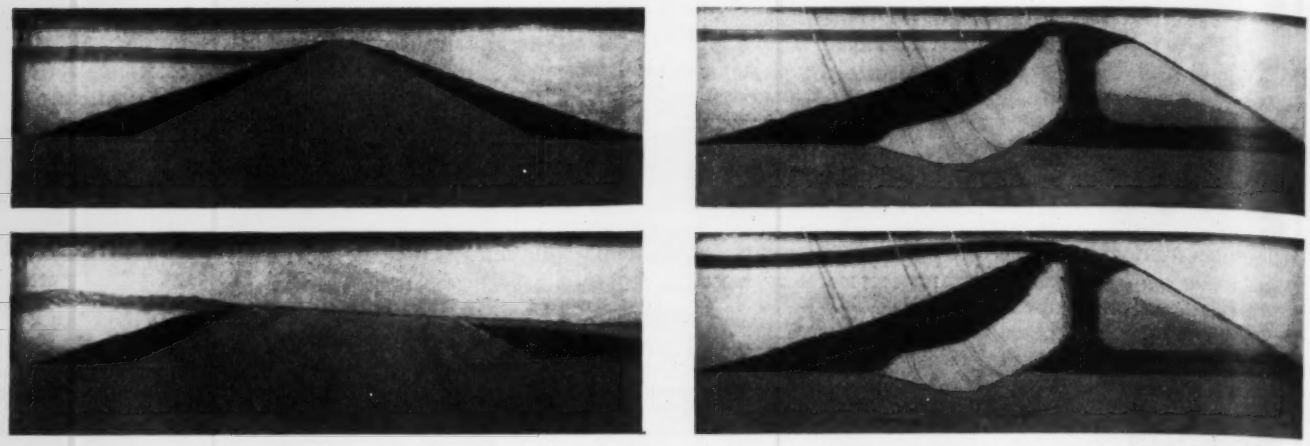
ECCENTRIC CORE MORE EFFICIENT THAN USUAL CORE

If scarcity of impervious materials is acute, a major reduction in size of core can easily be effected. By the conventional method the symmetrical character of the standard section is retained, but the side slopes of the core are steepened as much as may be needed. This results in a relatively horizontal seepage flow with a resultant flat seepage force vector like that shown in Fig. 3 (*a*). The flatness of this vector is objectionable as it tends to "unbalance" and intensify shearing stresses in the foundation.

An essentially downward rather than horizontal direction for seepage is more favorable to stability and may be obtained by inclining the core section as shown in Fig. 3 (*b*). In this case the seepage force vector intersects the base "within the middle third." (See also Fig. 5, *b*).

A further disadvantage of the conventional, triangular shaped core is the uneven distribution of flow evidenced in Fig. 3 (*a*). This prevents the most effective use of the impervious material. Experiments made with a series of models constructed with successively steeper core slopes showed that increase of total seepage through the model was not in direct proportion to the amount of material removed. When appreciable seepage is possible through the foundation, distribution of core material to serve simultaneously as a water stop in the embankment and as a blanket for the foundation is advisable—a procedure that also adds to the desirability of using some other form than the usual triangular core section.

What might be accomplished if all selected sections of a non-homogeneous embankment were reduced to mini-



(*a*) Model of "Standard" Section (*b*) Model of Section with Inclined Core

FIG. 5. INFLUENCE OF INTERIOR DRAIN IN REDUCING WAVE DAMAGE DEMONSTRATED IN MODEL TESTS
Dye Lines Illustrate the Advantage of the Change in Seepage Direction

mum proportions of the most efficient shape and arrangement is illustrated in Fig. 4. This design is essentially a further modification of that shown in Fig. 2 (*a*). Only enough pervious material is retained in the upstream shell to meet drawdown requirements; an impervious core section of efficient design is provided; and disposal of seepage water is handled by an interior drainage system of pervious material, all of which is effective. "Transition" sections are eliminated as being more desirable theoretically than practically, although filters are provided where needed. The arrangement permits inclusion of a sizable random section as previously recommended.

DRAINAGE SECTION DAMPS WAVE VIOLENCE

A special feature of the section shown in Fig. 4 is the improvement of stability against wave wash. Such protection, in addition to the usual ripraping, has received attention in several existing designs. The Quabbin Dam in Massachusetts, for example, has a "wave breaker" of heavy stone near the water line. Others make use of a concrete spray wall. In the design shown in Fig. 4, it will be noted that the upstream face of the dam is relatively steep at the top and that the material in the upper section of the upstream shell is designated as being particularly pervious. The intention of this arrangement is to damp out the waves by inducing them to drive directly into the shell section instead of "riding up" on the face and overtopping the dam.

Connection of the downstream drainage system to the upstream shell across the top of the core has been found experimentally to facilitate this action since excess surges are carried off through the drains and discharged downstream. Maximum effectiveness of this system would be obtained with quarry rock but even ordinary pervious materials such as sand and gravel afford some advantage over the traditional form of construction.

The interior drainage type dam of Fig. 4 was found to possess a surprising degree of stability against wave wash in comparison with the standard dam when both were tested in a model tank. Figure 5 shows the effect of the same degree of wave action on the two types of design. Although no attempt at securing dynamic similitude was made in these qualitative studies, the results are thought to be significant. The dye lines in Fig. 5 (*b*) show the direction of seepage flow through the core and the interior drainage section with normal reservoir conditions. This may be compared with the flow net for the standard dam (Fig. 3 (*a*)).

Closely related to these design problems is the problem of field control. It is the writer's observation that the best of the available methods is inadequate. Records of results obtained in one stage of the work may be secured and used to some extent as a guide for similar operations in some other stage or for permanent record, but methods of analyzing compacting effort to obtain a tangible basis for ordering more or less rolling or additional wetting or drying while contractor's equipment is still working are not believed to be generally available. For this reason it is proposed that field tests to determine such factors as the required number of roller passes, the weight and spacing of teeth on rollers (or best type of roller), the optimum moisture content, and the amount of compaction actually required should be included in the preliminary investigations. When these matters have been satisfactorily worked out, specifications can be prepared, based on the requirements for the job in question. It is believed that if sufficient observation of construction operations is then provided to insure consistent compliance with these specifications, the desired results will be obtained without an elaborate (and relatively expensive) program of soil tests.

LIBERALIZED COMPACTION REQUIREMENTS MAY MEAN STRUCTURAL ADVANTAGE AS WELL AS ECONOMY

Degree of compaction, like design, should also be based upon definitely established, rationally determined criteria. Here again tradition has in some instances been the principal basis for adopted standards because vital requirements have been insufficiently defined. The practice of specifying as many as thirty or more trips of a compacting unit with the object of obtaining unit weights of embankment materials comparable to those of concrete can only be justified if the nature of the embankment design is such that this degree of density is required for stability or impermeability. In some such cases modification of design to permit liberalization of compaction requirements might prove more economical. In other cases, over-compaction may be not only uneconomical but actually injurious to the structure, since elastic rebound and potential swelling forces of considerable magnitude may be induced.

In conclusion it is desired to reemphasize the contention that there is much room for improvement in earth-dam design and construction through clarification of basic criteria and through the use of greater ingenuity and common sense in employing materials that are immediately available.

New Monarch Pass Highway in Colorado

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and John S. Marshall, Assoc. M. Am. Soc. C.E.
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THREE periods have characterized transportation in this area of Colorado: first a rugged mountain highway superseded by a narrow-gage railroad; then, forty years later, a switchback auto road; and now, in a third location, a modern highway. Determining the new route posed a problem in economics. Length, curvature, elevations, grades, cost, vehicle operation, and snow maintenance all were studied for the three alinements. These elements combined with serviceability dictated choice of the Agate Pass location. In addition to the economic studies, construction problems are briefly discussed in this interesting paper, originating in a Highway Division session at the Society's Annual Convention in Denver, Colo.

ONE of the principal transcontinental travel routes through Colorado is U.S. Highway No. 50. Extending from Annapolis, Md., to San Francisco, it reaches its highest elevation at Monarch Pass on the continental divide in Colorado. A recently completed reconstruction of this highway over the continental barrier has opened the way to new motoring convenience and a far more efficient all-year highway service on this route.

Plans for the improvement of Monarch Pass involved many problems peculiar to rugged, mountainous locations. Following the early pioneer trails, the first wagon road was constructed in 1879–1880 over the Marshall Pass route (Fig. 1) to serve the gold rush traffic into the Gunnison area. Otto Mears, Colorado's famous pioneer road builder, constructed and for several years thereafter operated this as a toll road. Later he sold his right to the Denver and Rio Grande Railroad which constructed a narrow-gage line over the route. This railroad is still in operation.

Subsequently a wagon road was built over Monarch Pass. Then, in 1921, the route was relocated and made suitable for automobile travel by the U.S. Bureau of Public Roads in connection with a forest highway project. The line was selected at that time to provide primarily for forest needs and to furnish service to a few small communities. A 16-ft width of roadbed, switchbacks with curves of 50-ft radius, and grades of 7% were adopted. Between 1921 and 1937, the state widened the roadbed during maintenance operations, providing a minimum width of approximately 22 ft.

Realizing the need for more adequate highway service over the continental divide between Salida and Gunnison, the State Highway Department in 1935 initiated surveys to eliminate bottleneck conditions and to improve the route for increasing traffic demands. The object was to secure the most direct high-standard line with grades generally not over 6%, curvatures not over 16°, and a sight distance sufficient for a speed of 40 miles per hour; also, to serve the greatest volume of traffic with the greatest benefit to contiguous communities.

First investigations of the Marshall Pass route were followed by studies to improve the old Monarch Pass road. Then modifications of these lines to reduce distance, curvature, and grades were sought, with the result that for a finally constructed length of 28.4 miles between common points of Poncha Junction and Sargents (Fig. 1), 70 miles of reconnaissance lines were considered, and, 107.7 miles of completely surveyed lines were studied. The search led to a new line over a lower pass at the head of Agate Creek, approximately three-quarters of a mile southeast of old Monarch Pass, and thence down the Agate Creek drainage area to Sargents.

On each of three possible routes (Figs. 1 and 2) several alternate lines were investigated to determine the best solutions in certain localized areas. Thus the routes were brought to a comparable basis, as indicated in Table I.

This summary was complicated somewhat because of the construction work required on these routes regardless of the line selected for east-west through traffic. However, since analysis showed that the resulting construction cost and the vehicle-miles of travel were approximately the same, no correction was required.

In addition to its direct saving in distance, the Agate Creek route had the advantage of saving in certain bypass travel. Its large underrun in amount and intensity of curvature is a big factor in easier maintenance, more economical operation, and greater safety.

Rise and fall, and maximum elevation at the divide are in favor of the Marshall Pass route. To obtain this

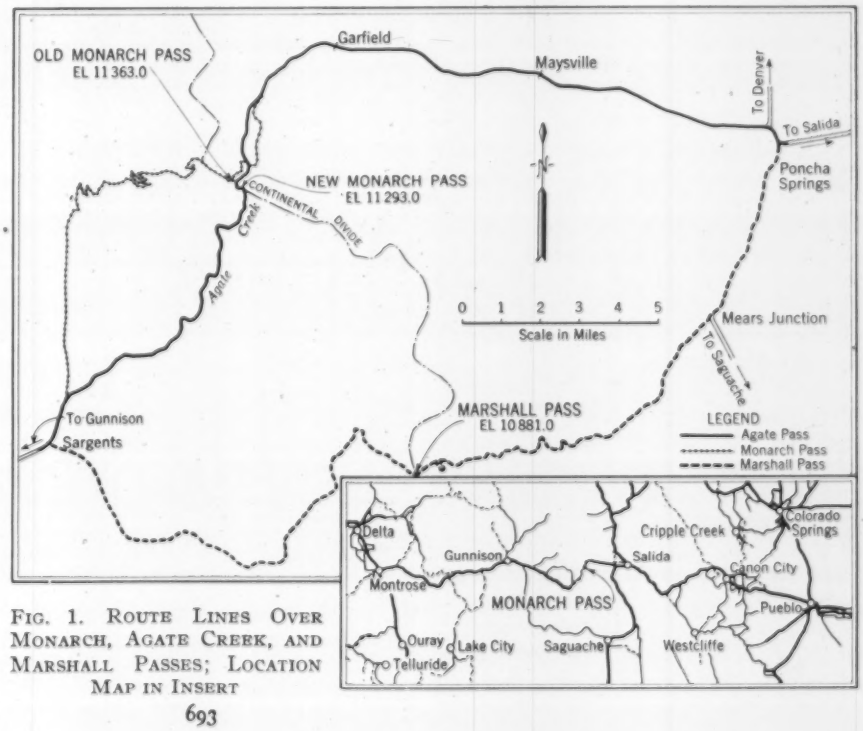

FIG. 1. ROUTE LINES OVER MONARCH, AGATE CREEK, AND MARSHALL PASSES; LOCATION MAP IN INSERT

Albert Haanstad, Denver, Colo.

A NOTABLE PROJECT IN MOUNTAIN ROAD BUILDING
Light Cut in a Less Precipitous Section

advantage, however, it is necessary to sacrifice practically every other item of design, such as distance, curvature, and construction cost. The elevation at Marshall Pass might indicate an advantage in snow conditions, but this is not the case. The railroad company's experience shows that this pass has been continually blocked by snow for periods of more than two weeks. Similar severe conditions are experienced for a distance of approximately three miles each side of Marshall Pass.

TABLE I. COMPARABLE DATA FOR THREE ROUTES BASED ON TYPICAL SURFACE WIDTH OF 24 FT

ITEM	MARSHALL PASS ROUTE	OLD MONARCH PASS ROUTE	NEW MONARCH PASS–AGATE CREEK ROUTE
Length (miles) between common termini at Poncha Springs and Sargents	30.242	33.925	28.436
Curve data:			
Total curvature	6,757°	7,760°	4,394°
Total number of curves	166	176	102
Number of curves greater than 16°	16	52	0
Maximum degree of curve	53°	90°	16°
Corresponding radius (feet)	108	63.7	358
Total curve length (miles)	16.202	13.321	11.928
Length (miles) on tangent	14.040	20.604	16.508
Rise and fall (feet)	5,978	6,871	6,766
Maximum divide elevation (feet above sea level)	10,881	11,363	11,293
Maximum grade	7%	7%	6%
Estimated construction cost	$1,972,810	$1,400,000	$1,556,010
Estimated annual vehicle operation cost (1945)	$ 494,024	$ 564,128	$ 466,487

In maintaining roads over Monarch and other passes the Highway Department has found that a mere difference of a few hundred feet in elevation results in very little, if any, change in snow removal problems. Exposure to the action of the sun is important. Both the Marshall Pass and the Agate Creek locations have generally good exposure.

Snow conditions on the Agate Creek route are as favorable as may be expected on any of our high mountain passes. Much of the route lies in timbered country with well-exposed side-hill cuts where little drifting results and snow removal is largely a side-casting operation. Added advantages in length, curvature, and other details necessary to provide adequate service to traffic were more than enough to dictate choice of this route in preference to the somewhat cheaper Old Monarch Pass location.

Any vehicle operation cost studies, such as those summarized in Table I, are subject to assumptions which can involve innumerable combinations of conditions, and the results will vary accordingly. It was estimated that traffic in 1945 would amount to 550 vehicles per day, of which passenger vehicles would constitute 80%; trucks of 5 tons gross weight or less, 10%; and trucks over 5 tons gross, 10%. Normal operation costs for vehicles were assumed to be as follows: passenger cars, $0.05 per mile; light trucks, $0.07; and heavy trucks, $0.15. It was expected that gasoline would cost $0.20 per gal.

Of course gasoline mileages were estimated to vary with the grades (using data in "Motor Vehicle Power Requirements on Highway Grades," by R. A. Moyer, 1934 edition of *Proceedings* of the Highway Research Board). For passenger cars at 30 miles per hour, 20 miles per gal was assumed on the level, 10 miles on 7% grades up, and 50 miles on 7% grades down. For light trucks the corresponding gasoline mileages were 14.7, 4.8, and 25.0, while for heavy trucks they were 11.6, 1.6, and 8.0 (this latter for third-gear operation).

It is generally conceded that the operation cost of vehicles on curves is greater than on tangents, and that the larger radius curves are preferable to the shorter. The principal item of cost affected by alinement appears to be the loss of time due to increased distance and to reduced speed on curves.

DRIVING TIME EVALUATED

Normally about one-third of passenger-car traffic and all truck traffic are of a commercial character, and delay to these classes of vehicles represents a distinct cash loss. Also, much non-commercial traffic would pay, if permitted to do so, to avoid the inconvenience of delays. Therefore for this phase of the comparison it was assumed that driving time has an average value for passenger cars and light trucks of $0.01 per minute, and for heavy trucks of $0.02 per minute.

Driving time over each route was estimated on the basis of curvature, grades, and other details. In this way speed zones were established varying from 40 miles per hour for curves of 14° or less down to 15 miles per hour for curves of 56° to 90°. On this basis, the driving time for passenger vehicles on the three routes was determined to be: Marshall Pass route, 46.5 min; Old Monarch Pass route, 56.06 min; and Agate Creek route, 43.07 min. Summarizing all these vehicle operating costs gave the comparable figures indicated in the last item of Table I.

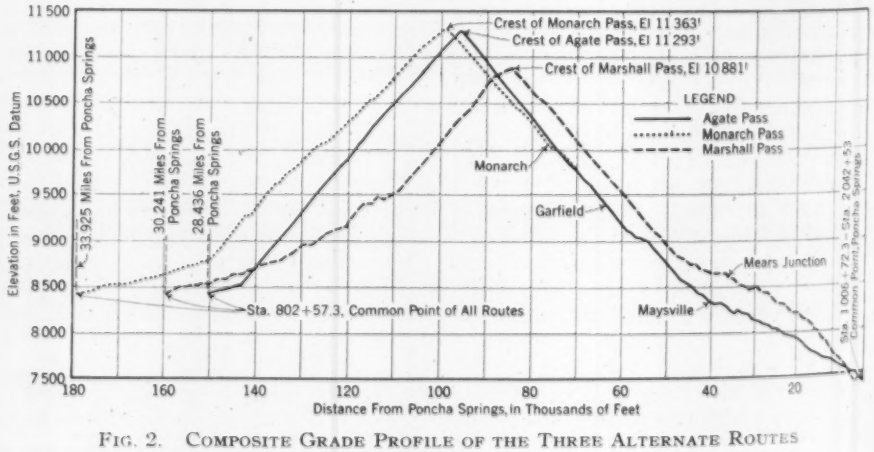

FIG. 2. COMPOSITE GRADE PROFILE OF THE THREE ALTERNATE ROUTES

Such a highway route should render the maximum service not only to through traffic but also to communities in the immediate vicinity. In this respect the new Marshall Pass–Agate Creek line is considerably superior to the others.

West of Marshall Pass, interference with the railroad tracks prevented line shifts from obtaining an economical balance of quantities or disposal of materials. Grades, even using the extreme curvature, resulted in unreasonably heavy excavation quantities. In general, the terrain on this route does not support a desirable highway location.

By comparison, the Agate Creek route also presented heavy construction work, but analysis showed that a higher standard of improvement for less cost was available. Thus it was determined that the most favorable route from the standpoint of distance, curvature, grades, estimated construction cost, estimated annual vehicle operation cost, community service, and ease of construction was the New Monarch Pass–Agate Creek line.

Construction on the new alinement between Poncha Junction and Sargents progressed under five contracts. Actual work began on October 24, 1938, and the new highway was completed on November 24, 1939, or approximately six months in advance of the required completion date. This rapid construction progress was due to excellent coordination of the contractors' operations, although a late dry season was a contributing factor. As a result the public had the use of the new route during the winter season of 1939.

UNCLASSIFIED BIDS USED

The principal contract item was "unclassified excavation," which included gravels, light soils, and some shales at lower altitudes with both disintegrated and solid granite at higher levels. In Colorado we require an unclassified bid; a probable estimate of the excavation as a whole would have shown approximately 50% solid rock and 50% common excavation. Bid prices on this excavation ranged from $0.20 to $0.47 per cu yd with a weighted average price of $0.375 for the entire project.

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NEW HIGHWAY WINDS UPWARD ON EASY GRADES

Drainage structures at this high altitude were all small and a minor part of the contracts. Three multiplate culverts ranging from 90 to 130 in. were in the drainage system.

Since much of the construction at the higher altitudes was on fairly steep slopes and consisted of deep cuts and fills, the State Highway Department's practice of heavy benching in supporting slopes was followed. Embankments were then carried up from low slope levels in carry-all scraper lifts, or where trucks were used, the bulldozers spread and compacted the fills. The granite material thus handled made excellent embankments.

Albert Haanstad, Denver, Colo.

MAGNIFICENT SCENERY GREETS THE MOTORIST ON THE NEW ROUTE ACROSS THE CONTINENTAL DIVIDE

Contractors' plant consisted of the usual mountain equipment of $1\frac{1}{2}$ to $2\frac{1}{2}$-yd shovels, trucks, bulldozers with tractors, carryall scrapers, rippers, compressors, and drilling equipment. In areas of disintegrated or broken granite a large yardage was loosened by tractor and ripper. The westernmost contract (6 miles) presented the most difficult construction, as approximately three miles on the side of high granite cliffs was accessible only from the lower end of the project. The work was opened up by a pioneer trail on the grade line. Powder and supplies were packed in on burros or by man power to advance cuts. Air lines were carried ahead in pipe lines with flexible joints. Wagon-type drills were extensively used. In general, it was necessary to complete the section as the work advanced. This contract averaged approximately 165,000 cu yd per mile. Very heavy slides occurred through this area, as the granite was full of slip planes.

SCENIC ATTRACTIONS PRESERVED

Especial attention was paid to the cut sections in areas of disintegrated granite, and the outside slopes of through cuts were taken out to slopes of 3 on 1 or 4 on 1. This was to prevent erosion and also to provide a place for snow removal. A number of scenic areas were daylighted in view of the proposed roadside development project for which funds have now been allocated.

Gravel surfacing was placed on 13.9 miles of the project while a crushed limestone surfacing 8 in. thick was provided on 14.5 miles. Cable guard rails and guard posts with reflector buttons were placed on all curves and dangerous sections.

Oiling of the entire project has also been undertaken. On the 13.9 miles of gravel surface a $1\frac{1}{2}$-in. oil mat 22 ft wide, using SC-3 oil, has been constructed; on the 14.5-mile limestone surface a double bituminous surface treatment approximately $\frac{3}{4}$ in. thick has been provided, using a prime coat of MC-0 oil, and two applications of RC-4 oil for the cover coat of aggregate up to $\frac{5}{8}$ in.

The new Monarch Pass Highway thus takes its place as a notable project of mountain road building. It combines to advantage the elements of economy, safety, usability, and scenic beauty.

Work was under the direction of the State Highway Department, for which Charles D. Vail, M. Am. Soc. C.E., is state highway engineer. Credit for the study on the Monarch–Agate Pass route is due to R. E. Cowden, location engineer. The writers were in charge of surveys and construction, and of plans and design, respectively.

Proposed Standards for Land Descriptions

Abridged from a Paper Presented Before the New Jersey Society of Professional Engineers

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AT some time in his work almost every engineer is harassed with difficulties in locating property lines for land needed by construction. To describe property adequately for all future needs Professor Kissam here suggests six rules. He concludes that the description should be in the form of an engineer's drawing in preference to the old write-up by metes and bounds.

THE only permanent records that remain after a land surveyor's work is done are the descriptions that are recorded in the deeds. The marks that he sets are lost or destroyed; the field notes are filed in some attic; the laborious computations and careful measurements obtained with such effort are forgotten with time. The most important written evidence bearing on the location of property lines is the recorded descriptions. On them depend the ownership of the greater portion of the wealth of the country. They provide the most useful means of tracing titles, and their importance cannot be overestimated.

As the responsibility for drafting descriptions is usually in its hands, the engineering profession might well develop standards for descriptions that could be used generally. Under present conditions title companies, real estate brokers, lawyers, and title examiners, all have their particular requirements which must be met and it becomes a difficult task to draft a description that will satisfy everyone and in addition be adequate for the land surveyor.

DUAL NATURE OF TITLE DETERMINATION

To determine the title to real estate it is necessary to ascertain who owns it and where it is located. If either of these determinations is neglected the other becomes valueless. While only a court of law can make a final decision, it is the function of the title examiner to discover as best he may who owns the property and the conditions of ownership, and it is the function of the land surveyor to determine its location and the physical conditions that modify its extent. The interdependency of these two roles is of signal significance although it is frequently overlooked.

In order to perform his part, the title examiner must look into the history of the title while the surveyor must study the history of the property lines. The dual nature of title determination is especially provided for in deeds. Besides proclaiming transfer of title, the deed must clearly state the identity of the parcel and its precise location. These last two functions are performed by the description. If the parcel is not properly identified, title cannot be traced, as the only certain connection between various instruments which affect title is the identity of the parcel as found in the descriptions. Also the description must define the locations of the boundaries of the parcel so that the land surveyor can mark the property lines on the ground.

Descriptions have been written which accurately identify the land but entirely fail to define the location of the boundaries. When the land is described only by naming the adjoiners, it is completely identified but cannot be marked on the ground. In the U.S. Public Land system, naming the proper quarter section will give perfect identification, but unless the section corners are still in existence the exact location is still in doubt. In the same category is a lot and block reference where no monuments have been set (a practice which is fortunately nearly eliminated today). On the other hand, many metes-and-bounds descriptions give the precise location of the property but fail to identify it. For example, consider two farm surveys having their points of beginning at monumented points on public roads. From the description it is impossible to know their relative positions. If one farm is meant to be a partition from the other, the title examiner has no means of knowing whether or not the partition is in fact part of the original farm. Or when a new survey is made for a plot that has not recently changed hands, and the original survey is inadequate, frequently it is impossible to identify the new description as referring to the same plot as the old description.

Thus the description has two functions and unless each is properly fulfilled the description is inadequate. It is natural that in reviewing a description the lawyer looks to the identification of the property. Proper identification and precise location are so much alike that frequently both seem complete when only one is fulfilled. On the other hand surveyors often inadvertently fail to provide proper identification. Hence the need of these tests:

1. Does the standard description completely identify the property so that the title can be surely traced?
2. Does it include all the necessary data to mark the boundaries on the ground?

SIX RULES PROPOSED TO STANDARDIZE DESCRIPTIONS

Six rules, which are here proposed for standard descriptions, ensure the fulfillment of these requirements and can be applied immediately with very little change in our present form of descriptions. When any data are to be used, their accuracy must be judged. Usually, a fairly clear idea of the reliability of a description can be obtained if the source of information is known and the training and ability of the writer can be gaged. Hence the first three rules are:

Rule 1. Each description in a recorded deed should bear the name of the person responsible for the description.

This important rule has nearly always been followed. Unfortunately it has recently fallen somewhat into disuse. Not only does it give information but it fixes responsibility. We all know that the work of some surveyors is better than that of others, and it is important to know also whether the description was the work of a land surveyor, a lawyer, or a real estate broker. It might be well to supplement this rule by requiring that the professional license of the surveyor be included.

Rule 2. All recorded descriptions should include the date when the person whose name appears upon it was assured of its accuracy.

Such a rule would eliminate the inane practice of recopying ancient descriptions through transfer after transfer, without a field checkup or at least an indication that the last final checkup did not occur many years ago. When a description is copied word for word from one deed to the next, it provides perfect identification and of course is a boon to the title examiner. The trouble is that many unrecorded rights or easements may have accrued or adverse possession may have become effective after the date when the grantor obtained title. Also, when two or more descriptions based on surveys of different dates are compiled, this fact will become apparent when dates are used. All experienced land surveyors know the difficulties which such a compiled description presents.

But perhaps the most scandalous practice that copying descriptions includes is a call for a monument no longer existing. When, for example, a tree was used as a monument in an old description, the new description should read "to a point where a tree once stood, now marked by an iron pin." Mention of the previous existence of the tree helps to identify the property and is good practice, but if the tree is gone when the description is written and dated, and it is referred to as though it were standing, the statement is next to perjury.

Rule 3. The source of the survey data upon which the description is based should be definitely stated. For example, in an extreme case, the wording might be: "From computations by Richard Roe, Land Surveyor, License 1501, April 1937, based on survey by John Smith, Land Surveyor, License 1502, made January 1936, description by Mary Jones, Real Estate Broker, License 1503, February 1939."

Note that these three rules do not require more services of a land surveyor. There can be no implication of selfishness in these proposals. No legislation would be required for their enforcement. It would be necessary only for the land surveyor to insist that in his descriptions these data be included. They would establish the authenticity of the description and fix the responsibility for its accuracy. Next in order are two rules (Nos. 4 and 5) that are necessary to insure the fulfillment of the dual role of the description:

Rule 4. The identity of the property must be clearly stated. For example, "Being the same tract (or part of the same tract) conveyed to *A* by *B* by warranty deed dated June 1934, and recorded in Book 100, page 100, July 1934."

In two typical cases this is particularly important:

(*a*) When the land is in the country it is sometimes impossible to discover whether the tract sold is actually part of the land owned without an intimate knowledge of local conditions. In this case the title examiner is unnecessarily delayed in tracing the title.

(*b*) When dimensions change either because of slightly different lines of possession or because of a more modern survey, unless the land is further identified by reference measurements to public streets, the title examiner is in a quandary.

Rule 5. The description should include survey ties to at least two durable monuments. If the street is monumented, the street monuments can be used as long as distances and bearings are given to both. If such do not exist, then at least two monuments must be set marking the longest property line. Obviously it is better to base the description on more than two monuments, in case one becomes destroyed or the property is fairly large. All monuments should have sufficient survey ties to permit reestablishing one that is lost. In other words, the best method is to base the description on a system of monuments interconnected by surveys. The state system of plane coordinates offers the most perfect system of monuments; in many localities such monuments have been established along the streets and highways, ready for immediate use. When all land surveys are made part of such a system many of the difficulties mentioned will disappear.

Rules 4 and 5 take care of the needs of the title examiner and the land surveyor. They ensure identification and location. Then there must be rule (No. 6) regulating the type of survey data which should be obtained and included in the description. There are many details that should form part of such a rule—too many to include in this paper.

Rule 6. All dimensions of property lines and all bearings shall be stated, and no "more or less" distances shall be used. All dimensions shall be based on a closed survey which has been checked by latitudes and departures.

As to the first statement in Rule 6, proper land surveying methods demand the location of the adjoining lines, and a "more or less" added to a distance entirely destroys the value of that distance. No purchaser of real estate should accept such a description because it affords no protection. Leave off decimals if you will, but let us rid ourselves of "more or less." When any dimension is omitted, or invalidated by such a reservation, the description is inadequate and the lines of possession, often impossible to determine, are the only protection to the owner.

These six rules can be carried out with little change in present methods of writing descriptions. In fact nearly all of them have been customary from time to time. They could be adopted at once without disrupting present practice.

CLEARNESS AN ESSENTIAL ELEMENT

Consider for a moment what would be the ideal form for a description to take. Above everything else it should be clear in its meaning. It should be expressed in such a way that it could be understood as easily by the layman as by the land surveyor. And yet how many persons can understand a land description as it is written today? No one, not even a land surveyor, attempts to do so. Every time a land description is used, a sketch is made of it. Why shouldn't a sketch be made at first, once and for all? I believe that a tracing on cloth should be substituted for the metes-and-bounds description. The original tracing should be attached to the deed and a lithograph copy on tracing cloth should be inserted in the book of record. This method has been used from time to time, with the modification that a metes-and-bounds description has also been included. In this case the metes-and-bounds must be compared with the tracing, an unnecessary waste of time. The question may by asked, "Will such an arrangement be safe?" In Massachusetts it is now exactly the procedure for registered property.

The advantages of a sketch are immediately evident. It requires less room in the record book, and provides a means of showing every detail that would aid in relocating the lines. It is less subject to error, as the scale and shape would indicate what was the intention when bearings become interchanged or figures reversed. In general it presents every item in such a way that no one can mistake its meaning. Where the lot or block description is used, a sketch would be unnecessary as the filed drawing would be sufficient. All the six rules mentioned would be included in the drawing. When the drawing includes references to the state coordinate system, no question can possibly exist as to the location of the property.

Technical Aspects of the Silt Problem on the Colorado River

By C. P. VETTER

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HANDLING the silt brought into canals by the water from the Colorado River was long a major operating problem of the Imperial Irrigation District in California. With the completion of the All-American Canal and the gigantic desilting works at its head, however, that problem is now solved. Mr. Vetter here discusses the research and theory on which the design of those desilting works was based. The studies undertaken dealt with the broad subject of the mechanics of silt transportation and with effects of the Boulder and Parker dams on the silt content downstream. Design principles for the works themselves are also discussed, with instructive reference to preliminary designs that were investigated and found wanting. The article is abridged from a paper presented before the Hydraulics Division at the 1940 Annual Convention of the Society in Denver.

IT was in the planning for the Imperial Dam, the diversion dam for the new All-American Canal, that serious consideration was first given to the silt problems of the Colorado River. In effect, two separate problems were involved. One deals, or dealt at the time, with a prediction of the amount of silt that would reach the point of diversion after the completion of Boulder and Parker dams upstream; the other involved the formulation of a design for desilting works that would assure the water users in Imperial Valley an uninterrupted flow of water as free of silt as economically practicable.

The earliest recorded silt observations on the lower Colorado were made at Yuma in 1892. Since 1911 the Bureau of Reclamation has made regular silt observations there twice a week and the Geological Survey has made observations at Topock, Ariz., since 1925, and at Yuma since 1926. No attempts were made to analyze the silt for size or to determine the amount of bed load. An examination of the records discloses that the silt load varies from a small fraction of 1% to as much as 5% by weight. It also discloses that the maximum silt content, as a rule, does not coincide with the maximum flow of the river. The spring and early summer runoffs, which result from melting snows at high altitudes, are relatively low in silt content, while floods in August and September, caused by local storms, carry great quantities of silt.

OBSERVATIONS AT LAGUNA AND IMPERIAL DAMS

In 1933 a more thorough program of silt investigations was initiated by the Bureau of Reclamation under the direction of E. W. Lane, M. Am. Soc. C.E. The purpose was twofold: (1) to establish, if possible, the extent of the bed load in relation to the suspended load, and (2) to determine the particle sizes of the total load and of the material constituting the bed of the river. The silt observations were made at the Imperial Dam site and at Laguna Dam 4.5 miles further downstream. At Laguna Dam the samples were taken at points along the overflow crest, in the Yuma Canal immediately below the point of diversion, and in the sluiceway at the canal headgates. It was thus possible to obtain a record of the total load of the river, that is, suspended load plus bed load. The silt samples were analyzed with sieves and hydrometers and the quantity, expressed in tons per day as a function of discharge, was plotted in seven particle-size groups ranging from larger than 0.25 mm to smaller than 0.005 mm. It appeared that in the coarser grades there is a fairly well-defined relationship between total load and discharge; but as the material gets finer the points scatter more and more, and no relationship appears to exist between the discharge and material finer than 0.01 mm.

At the Imperial Dam site measurements were taken of the suspended load only and the results were plotted in the same manner.

Finally, a series of borings was made between the Imperial Dam site and the Parker Dam site, 150 miles upstream, to determine the character of the material in the river bed to a depth of 30 ft. The average size of this material is somewhat coarser than that in the banks. It was found to range from about 0.05 to 0.6 mm. (270–28 mesh). This range of sizes is precisely the one for which the silt observations at Laguna and Imperial dams indicated a relationship between quantity and discharge.

Plotting of the samples disclosed no consistent difference between the total load at Laguna Dam and the suspended load at the Imperial Dam site. The conclusion was drawn that the suspended load constitutes by far the major portion of the load carried by the river. This conclusion is supported by the following reasoning. As a result of turbulence (originating largely at the contact surfaces between stream and bed) the water particles, and with them the suspended particles of solid matter, are constantly mixed. In the course of this mixing a certain number of silt particles will strike the bottom of the stream and, at the same time, a certain number of particles will be torn loose from the bed by the boundary layer and thrown into the stream. If the number thrown into suspension equals the number which, in the same time interval and on the same area, hit the bottom, the stream may be said to be in equilibrium and the silt content will be constant. In other words, if the silt-laden stream is in equilibrium, the intensity of the turbulence in the boundary layer must be sufficient to maintain a certain silt concentration in the layers adjacent to the bed. If this concentration is known, it is possible to calculate the concentration at any other depth. Since in the lower Colorado River the grain sizes of the bed material correspond closely to the grain sizes found in suspension, it seems reasonable to expect that particles torn loose from the bed by the disturbance in the boundary layer will remain in suspension until a descending velocity makes them again strike the bottom. Under these conditions true bed load is not likely to exist.

RELATION OF FLOW TO CONCENTRATION

This reasoning would also explain the observed fixed relationship between the discharge and that part of the suspended load that lies within the range of sizes available in the bed. As long as the discharge and the slope of the river are constant, the intensity of the turbulence in the

boundary layer, and the concentration of suspended matter maintained by it, are undoubtedly also constant. On the other hand the finer material, not available in the bed of the stream for many miles upstream from the point of observation, must originate elsewhere on the river or on its tributaries, and it cannot be expected that any fixed relationship will exist between this portion and the discharge. Bearing in mind that the term "saturation" should probably be used with caution in this connection, the phenomenon can, nevertheless, be illustrated by saying that the stream is saturated with the material freely available in the bed but undersaturated with material finer than that found in the bed.

Still another conclusion may be drawn from this reasoning. If the part of the silt load which lies within the range of sizes abundantly available in the bed bears a fixed relationship to the discharge, there is no reason to believe that this relationship will be materially changed if the finer part of the load is partly or entirely eliminated.

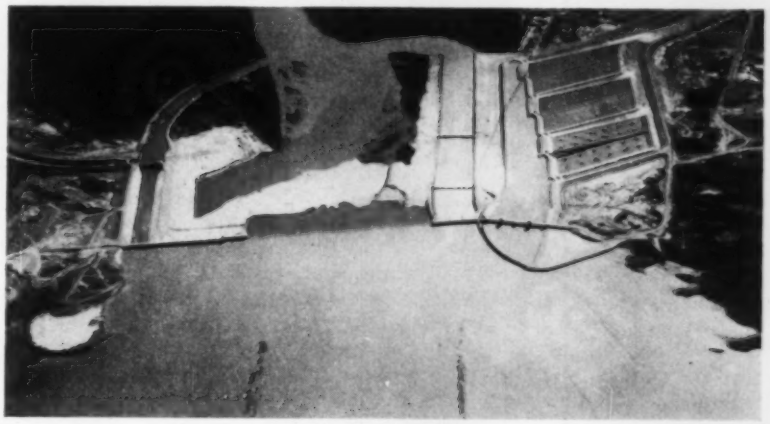
With these data and conclusions in mind, predictions could be made of the silt load that could be expected to enter the Imperial Reservoir following the completion of Parker Dam 150 miles upstream. (Imperial Dam and Parker Dam were planned for completion at about the same time.) The Parker Reservoir, with a storage capacity, to lowest water level, of 500,000 acre-ft, might conceivably hold all the silt that will be eroded from the river bed between the Parker and the Boulder Dam, which is another 150 miles further upstream. Except on rare occasions the outflow from Parker Reservoir will probably be clear for many years to come. Below Parker Dam the clear water will pick up material from the river bed until the stream has again become saturated with silt of the sizes available. The quantity of coarse material carried for a given discharge should be about the same as it was before the two dams were placed in operation; the fine material will be materially reduced. Where the river enters the Imperial Reservoir, the quantities would be as follows, for discharges of 18,000 and 40,000 cu ft per sec:

Size in Mm	Load in Tons per Day for Discharge of	
	18,000 Cu Ft per Sec	40,000 Cu Ft per Sec
0.25–0.10	26,000	100,000
0.10–0.05	40,000	170,000
0.05–0.03	39,000	130,000
Totals	105,000	400,000

To summarize, the conclusions drawn from the silt investigations were that at an approximately constant flow in the river of 18,000 cu ft per sec some 100,000 tons of solids per day might be expected to enter the reservoir; at times of higher flows the amount would be greatly increased.

Eventually the river will be stabilized, but the adjacent wide flat valleys afford an almost unlimited supply of silt. Various estimates have placed the total that may reach the Imperial Reservoir during the first 50 years of operation at several hundred thousand acre-feet. To build a dam high enough to store these very large quantities was practically out of the question; hence the solution was one calling for a relatively low dam, creating a reservoir of limited capacity, and necessitating other provisions for preventing silt in objectionable quantities from entering the All-American Canal. The next step, therefore, was the determination of the most suitable type of desilting works.

There is only one practical method of separating the heavier silt particles from the lighter water, and that is to take advantage of the difference in density. This may be done by letting gravity separate the grains from the water or by producing an acceleration greater than that of gravity by rotating the mixture in some sort of separator. It is obvious that for treating some 15,000 cu ft per sec the centrifuge idea would be wholly impracticable. We turned at once, therefore, to a consideration of sedimentation tanks.



LOOKING DOWNSTREAM AT IMPERIAL DAM
At Left, Flushing-Type Desilting Tank for Diversion to Gila Project; at Right, Desilting Works for All-American Canal

The first step in the design of a series of sedimentation tanks is the determination of their size. In this connection it should be borne in mind that as a rule absolutely still water is not obtainable in an engineering structure. Even at extremely slow velocities there is a residue of turbulence which originates at the point where the water enters. Additional disturbance is introduced by wind action on the surface and by other factors. Hence it should not be expected that the silt particles will settle to the bottom as they would in still water. The settlement will, however, take place according to the pattern previously described for the transportation of suspended silt in the river. On a unit area of the bottom of the tank, in a unit of time, a certain number of particles will strike the bottom, the number depending solely on the percentage of silt in the water immediately above the bottom. In a river in equilibrium with its bed, however, the same number of particles is lifted from the unit area in a unit time and thrown into suspension. It is obvious, therefore, that if a sedimentation tank is to operate at maximum efficiency, the intensity of the turbulence must be so low that no particles are returned into suspension once they have settled to the bottom. Preliminary investigations led to the conclusion that in tanks of the size contemplated for the All-American Canal, velocities of flow less than 0.25 ft per sec would probably not greatly disturb deposits on the bottom of the tank.

An additional assumption was necessary, or at least desirable, before quantitative results could be obtained. This concerns the distribution of silt concentration in a vertical line from the bottom of the tank to the water surface. Based on observations in numerous sedimentation tanks, the assumption was made that at any instant the silt concentration was constant from top to bottom of any vertical line. It has been mentioned that in a river this is not the case, the reason being partly that the intensity

of the turbulence decreases as the distance from the bed, or other boundary, increases. In a tank, however, the turbulence does not primarily originate at the bottom, and the assumption of constant intensity of turbulence seems at least a reasonable one. From the fact that the weight of silt which per unit of time and area is deposited on the bottom is proportional to the weight of silt per unit volume of water vertically above the unit area, the following expression is obtained:

$$\frac{\partial W}{\partial t} = -k \frac{W}{d}$$

where d is the depth of the tank at the point considered and W the total weight of solids in the vertical column of unit base area and height d.

The next difficulty is the determination of the constant, k, which is seen to have the dimensions of feet per second, or velocity. It can be shown that this constant has the value of the velocity of fall in still water, of a particle of the size considered.

Integrated, the sedimentation equation yields

$$W = W_0 e^{-\frac{k}{d}t}$$

in which W_0 is the weight of silt originally in the water and W, as before, the weight remaining after the time t. In a tank with parallel flow and constant depth,

$$W = W_0 e^{-\frac{kd}{q}x}$$

where x is the distance from the point where the water enters, and q the flow per linear foot of tank. In a circular tank with radially outward flow,

$$W = W_0 e^{-k\frac{\pi(r^2 - r_0^2)}{Q}}$$

where r is the radius to the point considered, r_0 is the radius at the influent circle, and Q is the total flow. From these relationships, the rate of deposition of the various grain sizes may be readily computed.

Before the final layout was decided upon, it was necessary to consider the means for removal of the silt from the bottom of the tank or tanks. The type of tank first considered, and the type finally adopted for diversion to the gravity main canal of the Gila Project, may be referred to as the flushing type. In this, the silt is allowed to accumulate on the bottom for a suitable period of time; then sluice gates at the downstream end are opened and the silt is sluiced to the river. In the basin for the Gila Canal, the sides and bottom are concrete lined, and the bottom has a slope in the downstream direction sufficient to maintain higher-than-critical velocity for the amount of water used in sluicing (approximately 3,500 cu ft per sec). The basin is 1,150 ft long and 19 ft deep at normal water surface elevation, with a cross sectional area of 2,900 sq ft, and is to handle a diversion of approximately 2,000 cu ft per sec. This gives a velocity of flow of 0.69 ft per sec, which is higher than the 0.25 ft per sec previously established as the maximum permissible. However, on the Gila Project the soil is somewhat more sandy than in the Imperial Valley, and slightly less efficient desiltation is permissible.

At a diversion rate of 2,000 cu ft per sec from a river flow of 21,000 cu ft per sec, the maximum theoretical efficiency of the basin is as follows:

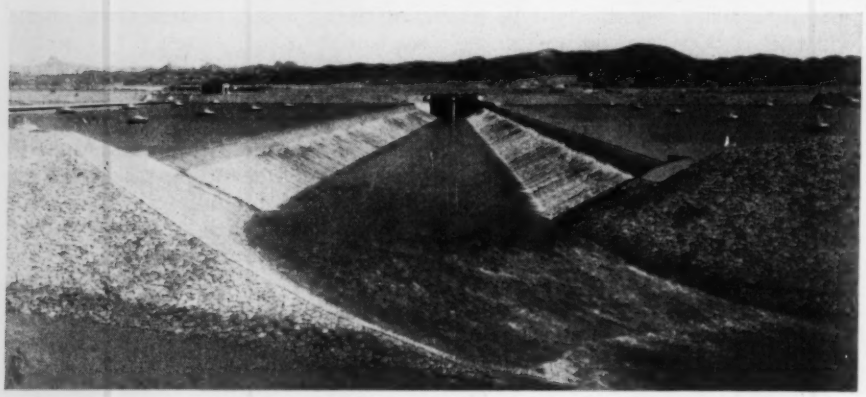
Size of Particles		% Removal	Tons of Silt Removed per Day
Mesh	Mm		
270	0.053	51	1,070
230	0.061	61	960
200	0.074	75	1,180
170	0.089	86	1,350
140	0.104	94	1,670
100	0.147	99	1,670
60	0.246	100	230
		Total, tons per day	. . .8,130*

* Of a total load of 10,500 tons.

The relatively high velocities in the basin will doubtless reduce these efficiencies during actual operation.

Flushing-type basins require relatively large quantities of water during periods of silt removal; hence they must be located to have a direct connection to the reservoir at their upstream end and to the river below the dam at their downstream end. In case great quantities of water are to be desilted, the width occupied by such basins is considerable. In the case of the desilting works for the All-American Canal, there was not sufficient width available for them without undue restriction of the spillway section of the dam. It became necessary, therefore, to investigate other methods for the removal of the silt deposited on the floors of the basins.

The most obvious solution would be to make the basin floors in the form of hoppers occupying the entire area, each hopper to be connected to a sludge pipe system, leading back to the river. By operating a number of valves, the hoppers could be flushed in rotation. Without going into further details, however, it is evident that the piping system required would be highly complex and that the great number of valves operating on pipes carrying a mixture of silt and water would present a continuous maintenance problem.



ALL-AMERICAN CANAL DESILTING WORKS, FROM EFFLUENT END

The only way in which the piping system could be simplified was to move the deposited silt laterally by mechanical means to some centralized collection points for flushing to the river. One such plan was investigated in detail. The basins were given a rectangular shape and over each basin a bridge was provided which traveled back and forth, scraping the silt into collector trenches, each of which consisted of a row of hoppers connected to a single sludge pipe. As the traveling bridge reached a collector trench, the valve controlling the flow in the sludge pipe under the trench was opened and the silt sluiced to the river. After a short interval of time, the valve was automatically closed. This plan was the lowest of those investigated in estimated cost, and the power consumption was also comparatively low. On the other hand, it had the distinct disadvantage that it required a great many automatic devices. In addition the problem of valve maintenance, although greatly re-

duced in comparison with the all-hopper plan, was still a serious one.

One type of basin investigated eliminated entirely the use of valves. This type consists of circular basins in which water is fed to each tank at the center and flows radially outward to effluent weirs at the periphery. The deposited silt is scraped toward a central silt hopper by rotating arms. Since only one sludge-removal pipe is necessary for each basin, the sludge removal may be continuous and no valves are required. The disadvantage of circular tanks is the comparatively high velocity produced near the center—far greater than the maximum permissible if silt once deposited is not to be brought again into suspension. In other words, in a circular basin only part of the area is actually effective as a desilting basin. Moreover, the power consumption is high, and the total requirement for power increases as the diameter of the individual basin increases. Hence, to reduce the power requirement it is necessary to use a great number of relatively small basins, and this again increases the original cost of construction.

The solution that suggested itself was therefore to place several of the rotating scrapers in one basin. In this way it was possible to keep the diameter of the individual scrapers relatively small without resorting to the multiplication of little basins.

The final design of the desilting works for the All-American Canal provided for three basins to be constructed initially, with room for a fourth to be added at a later date if required. In each basin were placed 24 rotating scrapers which push the silt to a hopper at the center of each scraper. Thence it is carried to a single sludge collector pipe leading back to the river. A full description of these works has been published previously in CIVIL ENGINEERING (article by D. M. Forester, M. Am. Soc. C.E., October 1938) and need not be repeated here.

The three basins were designed to desilt a maximum of 4,000 cu ft per sec per basin with a 50% overload of silt at a total river flow of 21,000 cu ft per sec. It was considered impractical to remove much of the silt smaller in size than 0.05 mm, and in any event, as such fine material would not be deposited in the canal, no maintenance problem would result.

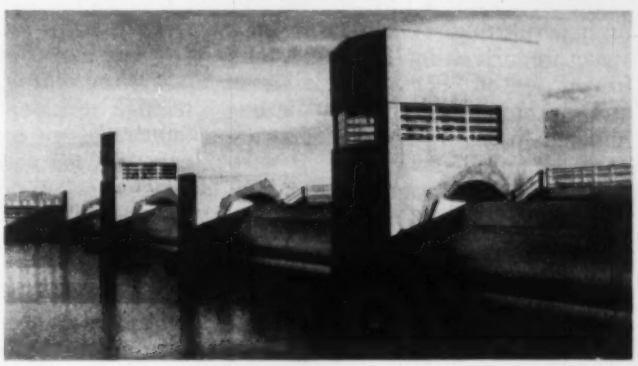
With the 21,000 cu ft per sec river flow, the silt load coarser than 0.05 mm would total about 105,000 tons per day. The initial three basins would desilt 12/21 of the flow, or approximately 60,000 tons of silt per day. With a 50% overload for design purposes, the total load for these basins would amount to 90,000 tons per day. Of this load, the amount of silt to be removed has been calculated as follows:

Size of Particle		% Removal	Tons of Silt Removed per Day
Mesh	Mm		
270	0.053	51.5	9,270
230	0.061	60.8	8,200
200	0.074	74.4	10,050
170	0.089	85.8	11,580
140	0.104	94.0	14,400
100	0.147	99.3	14,300
60	0.246	100.0	1,800
		Total, tons per day	69,600

In other words, from a load of 90,000 tons per day coarser than 270 mesh, it is expected that the desilting works for the All-American Canal can remove approximately 70,000 tons.

As has been mentioned, it was necessary to make certain predictions or assumptions to obtain a basis for the design of the two desilting works at Imperial Dam. The main conclusion drawn from the silt observations was that the rate at which silt of the coarser grades—that is, coarser than approximately 0.05 mm in diameter—would reach the Imperial Reservoir, would not be changed by the construction of Parker Dam, at least for many years to come. Since the closure of Parker Dam in 1938 there has been opportunity to observe the correctness of this conclusion.

Retrogression observations have been made below Parker Dam to determine the total volume of silt picked up from the river bed by the clear water discharged from the Parker Reservoir. Suspended load observations



LATE SHADOWS ON THE CANAL HEADGATES

have also been made of samples from the river water as it enters the Imperial Reservoir. As a first result it has been demonstrated that the total volume eroded from the river bed almost exactly equals the total volume determined by the suspended load observations in the river immediately above Imperial Reservoir. This confirms the assumption that practically all load travels in the form of suspended load.

Samples of bed material taken from the stretch over which active retrogression takes place below Parker Dam have indicated a slight coarsening of the bed material. It is apparent, however, that this is not yet sufficient to cause a change in silt transportation from suspended load to bed load.

As to the character and amount of suspended load transported by the river, the rate of transport of the coarsest grade, 0.25 to 0.10 mm, has been slightly increased. This phenomenon possibly reflects the coarsening of the average composition of the river bed material. In the size group 0.10 to 0.05 mm, the rate of transport has remained almost exactly the same as it was in 1933–1934, while in the size group 0.05 to 0.03 mm, a slight decrease in the rate of transportation has taken place. For the three groups taken together the rate of transportation has remained virtually unchanged, thus sustaining the general theory that, in a stream in which the bed and banks contain abundant material within a size range which may be transported in suspension at the prevailing rates of discharge and at the prevailing bed slope, the rate at which the load is transported depends on the discharge alone as long as the slope remains unchanged.

During 1939 the average flow below Boulder Dam was 12,300 cu ft per sec in comparison with a normal average runoff of 18,000 cu ft per sec. The result has been that, although the rate of silt inflow into Imperial Reservoir in terms of discharge has been exactly as anticipated, the total silt inflow, varying with the second power of the discharge, has been materially less than expected. This of course does not disprove the correctness of the assumptions on which the design of the Imperial Dam desilting works was based, but it has thus far prevented a test of the desilting basins at design flows.

Waterproofing a Brick Tunnel

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UNEXPECTED difficulties were encountered in trying to control seepage into a 75-ft stretch of a mile-long Erie Railroad tunnel. Grouting, patching, calking, pointing, and other expedients were tried. Last recourse was had to controlling rather than preventing seepage, utilizing a false arch or timber "umbrella" in combination with drainage. To the many readers who profit by a story of problems connected with a relatively small maintenance job, this detailed account will be welcome.

WHAT promised to be a rather simple job of repairing the lining of the Otisville Tunnel of the Erie Railroad proved surprisingly perplexing. This double-track structure, driven in 1907–1908, for a freight cutoff between Harriman and Graham, N.Y., carries the line under a high ridge of the Shawangunk Mountains.

It was cut through rock as indicated in Fig. 1 (*a*). The section shown extends for 4,290 ft, the remaining 1,024 ft being unlined. The arch proper consists of five rings of brick laid with the 4-in. dimension radial. Rows of headers spaced about 4 ft from center to center around the circumference serve to tie the rings together. Expansion joints 25 ft apart were formed by omitting half a brick in staggered rows and alternate courses to constitute an interlocking key.

The design probably represented good practice at the time, but judged in the light of present-day standards, it is lacking in one important particular—no provision was made for drainage of water which might accumulate behind the arc. As could be expected, this has had serious consequences. By about 1930, seepage had increased to such an extent as to foul ballast, with consequent expensive maintenance. Serious operating hazards were created in winter when massive icicles would endanger the running gear of locomotives and cars. Sheets of ice would sometimes be built up to the top of the rail and constant attention was required to prevent serious derailments.

Conditions grew steadily worse. Deterioration of the bench walls, caused by penetration of stack gases and progressive loosening of the surface by ice formations, had proceeded at some locations to a depth of 6 or 7 in., leaving the inner two rings of brick entirely unsupported. Occasionally brick would fall.

For the major portion, leakage was confined to a slow seepage at expansion joints and at the brick-concrete junction at the top of the bench wall. Accordingly, during 1937 studies were undertaken for repairing the bench walls and waterproofing and solidifying the arch. Operating requirements prohibited taking the tunnel out of service more than 6 hours a day. In addition, it was specified that side and overhead clearances should not be reduced by any permanent work. For the bench walls (Fig. 1, *a*), it was decided to remove the surface back to sound concrete, set anchor bolts and wire mesh, and restore the original line and surface with gunite. This material would tend to reduce penetration of stack gases and retard future deterioration.

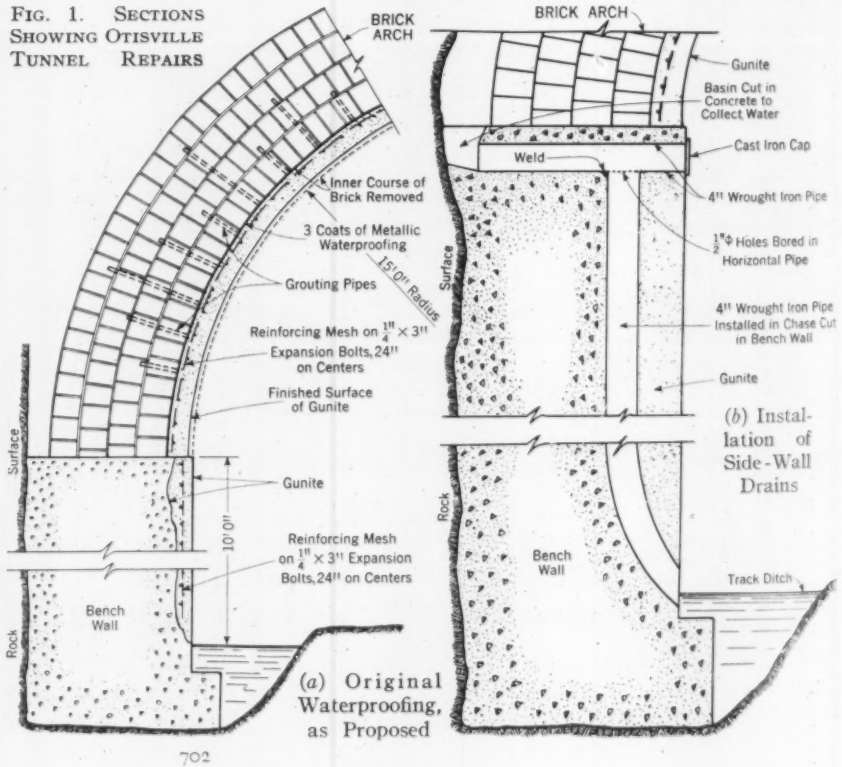
Waterproofing of the arch, particularly in view of the limitation on reducing clearances, presented a more difficult problem. The space behind was too small to permit working directly on the back face. Any proposed method would thus have to be carried out from inside the tunnel. Use of metal liner plates was first considered, and while this would have been a satisfactory solution, considerations of economy forced its abandonment.

Instead it was decided to remove the inner ring of brick, Fig. 1 (*a*), and replace it with gunite after grouting and waterproofing. Vertical wrought-iron drain pipes 10 ft from center to center (Fig. 1, *b*) were designed to correct the original lack of drainage.

A section of tunnel 75 ft long, where deterioration was especially pronounced, was selected for a test of the proposed method as described herein, with the thought that extension to other parts might await the results of the present repairs. Total flow into this 75-ft section amounted to about 94 gal per min, mostly slow seepage through all mortar joints. This was considerably heavier in the top one-third of the arch and at the header rows.

Six scaffold towers, erected on push cars, formed the construction trains of 3 cars for each track. A nearby siding was used for storing the complete outfit. Switching at the beginning and end of the day's operations,

FIG. 1. SECTIONS SHOWING OTISVILLE TUNNEL REPAIRS



and other unavoidable details totaled 1½ hours of unproductive work, to be deducted from the 6 hours available each day.

Installation of the 4-in. drains was started in October 1938. It was anticipated that in placing these the pocket behind the arch would be tapped, relieving the head of water it was assumed must exist there. However, of 16 holes cut, 8 were initially dry, and flow in the rest varied from practically zero to a maximum of 5 gal per min. One-inch test holes were then drilled entirely through the brick at other locations. None of these, however, disclosed the existence of any body of water and the original idea of a considerable head behind the arch had to be discarded. Nevertheless, it was felt the drains would be necessary after grouting was complete.

No change in the contemplated procedure was therefore considered desirable and removal of the inner course of brick was started. Examination showed the brick to be uniformly hard and non-porous. Penetration of stack gases in the mortar, however, varied from about 2½ in. in the upper portion to a minimum of ¾ in. near the springing line. Beyond the depth of gas action, the mortar was not generally porous. Minute water-carrying channels could be detected but these were widely spaced and constituted only a very slight reduction in cross-sectional area.

In view of this unexpectedly good condition of the interior mortar, some concern was felt as to the possibility of obtaining any travel of grout through the arch. However, it was decided to considerably reduce the spacing of grout holes and otherwise continue operations as planned. Holes 1¼ in. in diameter were drilled at intervals of about 3 ft to depths of 5, 10, and 15 in., penetrating the first, second, and third mortar rings, respectively. Then 1-in. pipe nipples, 7 in. long, were inserted a minimum distance of 4 in. and securely calked with lead.

GROUTING PRECEDES WATERPROOFING

A cement gun was used for grouting, a pressure being developed at the nozzle of about 150 lb per sq in. After experimentation, a 4:1 mixture of cement and metallic waterproofing was found most satisfactory. Hydration was accomplished at the nozzle as in normal use of the cement gun, though it was necessary to substitute a larger water ring to obtain a fluid grouting mixture. The quantity of water averaged about 3 gal per sack of cement. As might be expected, the amount of grout taken was exceedingly small, about 0.03 cu ft per hole on the average. Grouting was started at the west end of the test section, where seepage was least. Initially, operations were quite successful and it was found possible, in this area, to completely stop the passage of water.

Installation of expansion bolts followed, and then the first coat of waterproofing. The ingredients were mixed with sufficient water to form a heavy paste and brushed liberally over the face of the arch. It was specified that 24 hours should elapse between the application of successive coats to permit rusting of the iron filings in the waterproofing. The remaining operations in this area where grouting was successful offered no difficulty.

As grouting was carried beyond the west 40 ft, it became more difficult to completely stop the water. Total flow through the 4-in. drains at this time was 18 gal per min and that through the untreated part of the arch about 74 gal per min, concentrated principally in a length of 20 ft. In this length grouting was now attempted. By adding a "quick-hardening liquid" to the water, and holding full pressure on each hole for a period slightly greater than the setting time of the mixture, it was possible to proceed with the grouting another 4 ft, but at this point operations bogged down entirely. Other expedients were tried, including use of a powder form of set accelerator, which caused expansion of the hardening grout; but all were equally unsuccessful. Probably the pore spaces in the mortar at this location were too small to permit entrance of the cement particles.

Waterproofing and guniting were carried to the limit of the grouted area, and no satisfactory solution having been developed for handling the section of heaviest flow, it was decided to shift operations to the opposite end of the test section. There the same difficulties were experienced, but an additional 14 ft was grouted and gunited. A section 17 ft long out of the original 75 ft thus remained for which no satisfactory treatment had been devised.

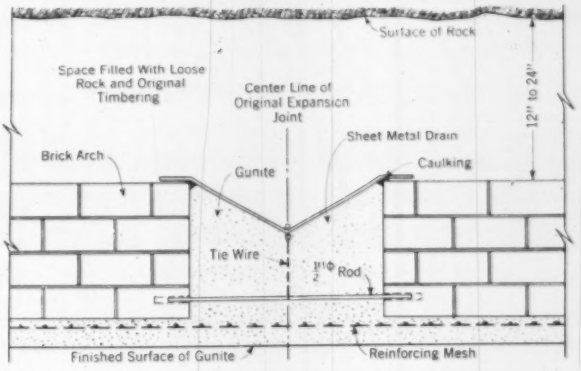


FIG. 2. LONGITUDINAL CROSS SECTION THROUGH V-DRAIN

Further inspection, through manholes driven at the top of the arch, showed that, as originally anticipated, space did not permit working on the back face. By this time, total flow in the side-wall drains of the test section amounted to 24 gal per min; while leakage through the arch proper in the 17-ft ungrouted length was about 66 gal per min, about 50% in one expansion joint. It was felt that if this could be controlled, grouting of the remaining area might be accomplished. A channel 24 in. wide was cut entirely through the arch from one bench wall to the other. A V-shaped metal drain was placed throughout this opening as shown in Fig. 2. The collected water discharged into the nearest side-wall drain.

Arch brick were removed for installation of this drain only with great difficulty. No penetration of corrosive gases had apparently occurred beyond the first course. Compression tests on representative specimens gave values of about 2,100 lb per sq in., in contrast to the 400 lb per sq in. found in the best of the interior ring of brick. This circumstance relieved any concern as to the fundamental safety of the arch (despite the percolation of water through it) and influenced subsequent construction procedure.

EXPEDIENTS FAIL TO CONTROL LEAKAGE

Action of the V-shaped drain was about as anticipated, and an additional 30 gal per min was diverted to the side-wall drains, leaving a total flow of 36 gal per min through the arch in the 17-ft section. Grouting was again attempted, with cement screened through a 100-mesh sieve, but results were no better than before.

It was suggested that by cutting entirely through the arch and forcing grout over the back surface, particles might be washed down into the voids in the mortar joints to effectively seal them. Though little confidence was felt in this possibility, the method was tried. Ap-

proximately 3 cu yd of grout mixture, with accelerator added, was pumped through at one location. No reduction in leakage resulted, so the procedure was abandoned.

Much of the remaining flow was confined to the longitudinal header rows, and a process known as "hot-patching," quite generally used in waterproofing concrete, was tried at these locations. A small area is undercut to form a pear-shaped hole and a quantity of cement mixed with liquid accelerator is held in it, usually from 30 to 60 sec, until initial set takes place. However, undercutting of the brick proved impossible as spalling invariably resulted, so this method also was a failure. Lead wool was then tried; by calking it into each mortar joint around the header rows, much of the flow at these points was stopped. However, this was a time-consuming task and therefore not economical for all the joints.

Several 1-in. "weep pipes" were placed, in the hope that the comparatively slow seepage would concentrate itself in these free outlets and permit the adjacent gunite to achieve a set. This was successful where a relatively small quantity of water existed, but was useless over the largest part of the area. Total flow through the 17 ft of arch now amounted to about 24 gal per min. It is difficult to appreciate how such a quantity of water over the large area remaining could completely prevent successful application of gunite, but it was found that even the smallest amount of slowly dripping water would be absorbed by the gunite and break the bond between it and the arch, causing large "falls." Addition of an accelerator failed to decrease setting time sufficiently to cure the condition.

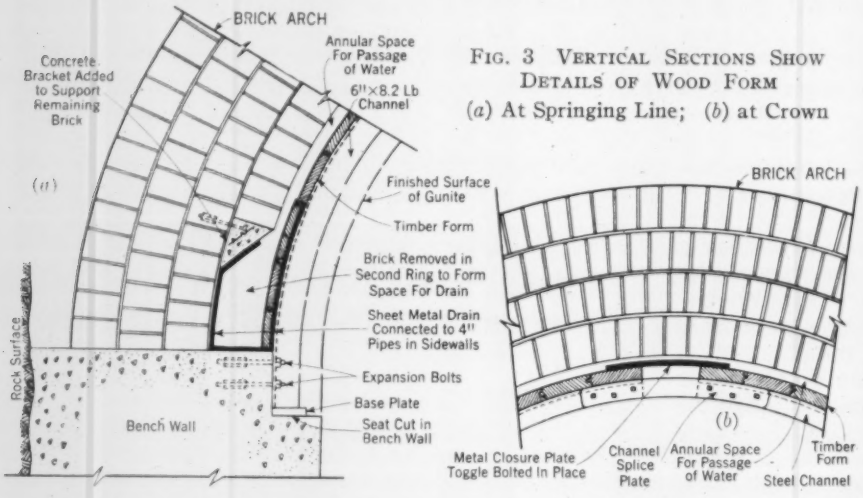


FIG. 3 VERTICAL SECTIONS SHOW DETAILS OF WOOD FORM
(*a*) At Springing Line; (*b*) at Crown

WOODEN "UMBRELLA" SUPPORTS GUNITE

Meanwhile winter intervened. During the period of suspended work, numerous plans were considered for completing the job. Limitations as to finances, clearances, and working time forced the abandonment of many otherwise acceptable solutions. The scheme finally adopted is shown in Fig. 3. It consisted, in brief, of erecting a wooden form or "umbrella," supported on semicircular steel channel rings resting on the bench walls.

This plan fulfilled only one of the original requirements—that is, it eliminated water from the roadbed, but it failed to strengthen the arch or prevent seepage. However, the masonry tests had considerably allayed fears for structural stability. Hence only erosion through percolation remained as a possible source of failure of the arch, and in view of the reduction of flow that had been accomplished, this possibility seemed too remote to justify any additional expense.

Wood rather than metal was chosen for the form as it seemed more adaptable to the piecemeal operations that were required by the limited working time available. In addition, it was felt that the natural swelling of the boards as they absorbed moisture would tend to automatically tighten the entire form. Subsequent decay of the timber, if it does occur, should not be serious.

Field work presented some difficulty. The semicircular steel channels (Fig. 3) consisted of four sections of equal length, bored to receive field-bolted splice plates. The upper ends of the bottom sections were placed 1 in. from the face of the arch and firmly braced to the scaffold towers. Strips of 1-in. by 6-in. tongue-and-groove sheeting, 16 ft long, were slid in behind the free ends of the channels. The tongue-and-groove joints were seated in heavy mastic and every fourth length was bolted in place to prevent movement when the wood swelled under the action of water. Where each board passed over the steel channels, a wooden wedge was placed between it and the arch, to prevent upward warping and minimize deflection under the weight of the gunite later applied.

When the forms reached the free ends on each side of the arch, it was necessary to place the remaining channels. Their lower ends were bolted to those already in place, the upper ends being braced to the scaffold towers as before. These last sections intentionally failed to meet at the top by a space of 7 in. and through this opening the remaining boards were slid into position and the timber portion of the form completed. Final closure was accomplished as shown in Fig. 3 (*b*). At the close of each working day, when scaffold towers had to be removed to clear the tunnel, the channels were temporarily secured to the arch with expansion bolts.

Considerable calking was necessary at the ends of the form where it joined the gunite already placed. It was specified that the initial coating of gunite should not exceed 1 in. in thickness to keep the load on the sheeting within reasonable limits. After this had set, the remaining gunite was to be applied as desired. The job was completed without further trouble, to the relief, as might be expected, of all concerned.

No trouble has been experienced with seepage through the gunite and it is felt that with the free outlets provided, none will develop. Flow in the individual sidewall drains varies from slightly less than 1 gal per min to a maximum of 16 gal per min. Total flow from all pipes amounts to about 90 gal per min as compared with 94 gal per min originally. Seasonal variations probably account for the difference in these two quantities.

Although not fulfilling all desirable requirements, these repairs seemed to be the best obtainable with the financial and physical limitations imposed. Subject to continued satisfactory performance of this 75-ft test section, similar treatment will be given to other sections of the tunnel as required.

The Pneumatic Construction Company performed the work described under the direction of B. Blowers, division engineer, and I. H. Schram, engineer of maintenance of way, Erie Railroad Company. The writer was in charge of design and field operations for the railroad company.

Economic Studies for Public Works

Their Value and Necessity, with Specific Reference to the Central Valley Project in California

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THE subject of economic studies for public works is a very broad one that comprehends the extensive field of public improvements and numerous variations in methods of financing. The authors have not attempted an exhaustive presentation of the subject, but have purposed rather to discuss briefly principles, practices, and procedures applicable to studies of the economic feasibility of public works. They speak from a background of many years of experience in this field. The paper was originally presented at the 48th Annual Meeting of the Society for the Promotion of Engineering Education in June 1940.

ECONOMIC considerations are, or should be, the constant concern of the public works engineer. Such considerations may range all the way from the more simple and frequent problems connected with economy of design to the more complicated ones of economic feasibility or justification and financial soundness. The scope of the economic studies required will vary with the type of improvement but more particularly with the source of funds and the method of financing.

Public works may be divided into two general categories based upon opposite extremes with respect to financing: (1) works that are financed and supported by funds derived solely from general taxes and in connection with which there are usually no tolls or charges or special tax levies; and (2) (at the other extreme) works financed and supported by funds derived solely from tolls or charges or special taxes. (Hereafter for convenience the term "toll" will be used to indicate any special unit charge for the use of a facility or service.) However, this differentiation is not an absolute one and there are many variations in actual practice. The financing of public works appears to be a matter of custom or policy, which has changed from time to time and is still changing. These policies may vary in different communities or sections of the country. Both methods of financing may be used for the same type of public works, even in the same community. There are also countless examples of public works that are financed and supported partly by general tax funds and partly by special tolls. It is this situation that gives rise to the wide variation in the scope of economic studies made by the public works engineer for the planning, construction, operation, and maintenance of public works; for the determination of economic feasibility and justification of such proposed developments; and for the analysis of plans of financing and determination of financial soundness.

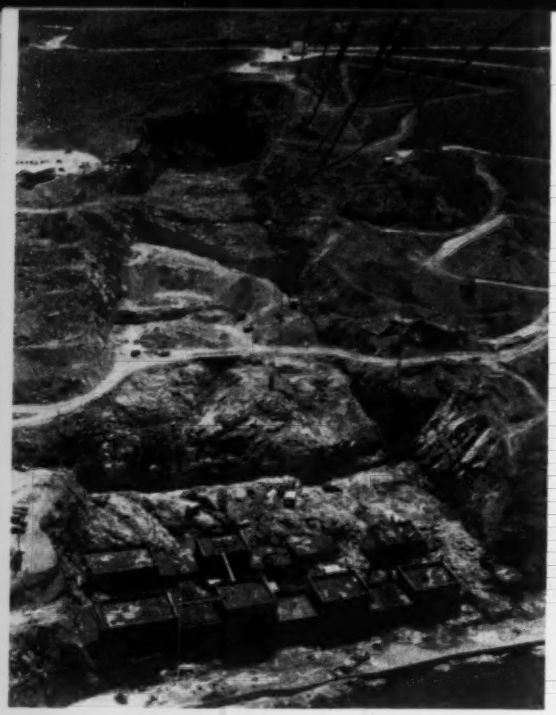
Public works in the first category—financed and supported entirely by general taxes—usually comprise improvements and facilities that are considered a necessity or at least highly desirable from the standpoint of the general safety, health, convenience, and welfare. In connection with such works, the question of economic justification usually does not arise. Benefits are involved that may be difficult or impossible to evaluate on a monetary basis. At any rate, necessity or desirability as expressed by the will of the people becomes the ruling factor.

Although such works, because of their paramount necessity, may be financed and supported from general tax funds, the policy in many cases is to carry them either wholly or in part by tolls or in some cases by special improvement taxes. This is largely a matter of local preference. But it may sometimes be a matter of necessity. In some cases the community may choose to finance a facility or improvement partly by taxes even though it could be financed entirely by tolls.

An example of this would be a municipal water or irrigation system for which all charges, both fixed and operating, might be borne by revenues received from charges for water. However, it is frequently the custom

A TYPICAL PUBLICLY FINANCED IRRIGATION DEVELOPMENT IN CALIFORNIA

Don Pedro Dam and Power Plant on Tuolumne River were built jointly by the Modesto and Turlock Irrigation districts with funds derived from the sale of bonds after careful studies determined the necessity and economic feasibility of the project and the ability of the districts to meet all carrying charges. Revenues from the sale of hydroelectric power reduced tax levies for irrigation supplies and resulted in a relatively low cost for irrigation water. Economic studies were checked by the State Engineer before the bonds could be certified as legal investments.



SHASTA DAM, MAJOR STORAGE STRUCTURE OF CENTRAL VALLEY PROJECT

This project, originally conceived as a state undertaking, is now being built under federal auspices by the Bureau of Reclamation. The cost of features chargeable specifically to improvement of navigation and flood control will come from federal funds without reimbursement, but the rest of the cost will be returned to the Government in accordance with the reclamation laws. The sale of water and power will probably provide the main source of funds for repayment, operation, and maintenance. The economic soundness of this project was demonstrated by a detailed financial analysis before the work was authorized.

to meet a certain part of the cost of such works, particularly the fixed charges, with funds derived from taxes.

In other cases conditions may be such as to make it impossible or impracticable to carry the financial load by tolls alone, particularly in the early stages of a development. One typical example is the urban transportation system. Such systems—both electric railway and bus—are notorious today as a class of public utility that does not pay. Revenue that can be obtained from the tolls that passengers are willing to pay is insufficient to meet fixed and operating charges except in a few favorable instances. However, a public transportation system is almost a necessity in a modern city and there are many who believe that it should be maintained even if a part of the expenses must be raised by taxes. Public works in this general class, however, may become self-supporting from revenues derived from tolls when the utilization of the facility increases sufficiently to produce the revenue required. This may be true, for example, of a city transportation system as previously mentioned, of a toll bridge, or of a large metropolitan water supply system such as those built for the cities of New York, San Francisco, and Los Angeles which have a very large initial investment to provide for many years to come.

With these wide variations in methods of financing, the economic studies that may be required will vary correspondingly. The more dependence is placed upon financing by toll charges or special taxes, the more careful and extensive must be the economic analysis to determine questions of feasibility, justification, or financial soundness. Consideration must be given to the type of charges to be made; how much revenue can be derived from them; how such revenues compare with total carrying charges under the methods of financing available; and finally, how much of the cost, if any, must be borne by general tax funds or by special taxes as the case may be.

The most exacting economic analyses are required for public works for which the carrying charges are to be met from a special source of funds—which may be revenues from tolls, or funds derived from special taxes, or a combination of both.

Public works in this category include facilities for water supply, electric power, and transportation; works for irrigation, drainage, reclamation, flood control, water conservation and storage; and various types of special improvements. Such works are usually financed by special bonds which are an obligation upon the area for which the works are constructed or upon the people who use the works. These bonds have usually been so-called "general obligation" bonds, intended to be a lien upon the property in the public agency involved and also upon the works or facilities.

In rather recent years, a new basis for public utility financing has grown up with the adoption of the so-called "revenue" bond, which is designed to be payable as to principal and interest solely from revenues derived from tolls and in no case to become a lien upon the property owners in the public agency involved. With this type of financing even more exact economic and financial analyses are required to demonstrate economic feasibility and financial soundness because dependence in meeting obligations must be placed entirely upon the revenues secured. The possibility of financing such public works—that is, the salability of the bonds, whether general obligation or revenue—will depend upon the conditions indicated by the results of such specific analyses.

One of the principal duties of the State Engineer of California is to make extensive economic studies. He is required by statute to report upon the feasibility of irrigation, water conservation, water storage, and drainage projects. The details of procedure under these statutes, which vary for different types of districts, are too voluminous to describe here. Suffice it to say that in general he is required to make comprehensive investigations, not only as to engineering feasibility but also as to the economic feasibility, justification, and financial soundness of such enterprises. It is largely on the basis of his investigations and reports that bonds issued by such districts are certified as legal investments for savings banks and for other purposes. At the present time, such bonds are validated for certification by the California Districts Securities Commission, of which the State Engineer is a member, and are actually certified by the State Controller.

MANY FACTORS ENTER INTO ECONOMIC STUDY

The studies that the State Engineer must make in reporting upon the feasibility of an irrigation project under the California Irrigation District Act may be considered as typical. They may include a survey and classification of soils as to quality and adaptability to crops and irrigation, determination of the adequacy of water supply as to quality and quantity, estimates of capital cost and annual expense of operation and maintenance of the irrigation works, studies as to the cost of preparing the land for crops and for irrigation, cost of planting crops, cost of crop production, probable farm revenue, and finally, an economic analysis to determine if the project is feasible under the possible terms of financing. The question of economics simply boils down to this: Will the revenue from farming under average conditions be sufficient to meet all carrying charges for the irrigation works (including fixed charges of interest and bond retirement and annual operation and maintenance expenses) as well as all expenses of farming, and in addition provide some profit to the farmer? If the economic studies do not show definitely that such would be the case the project must be considered as of doubtful economic feasibility.

Unusually extensive in scope were the economic studies required in connection with the formulation of the State Water Plan of California and the initial develop-

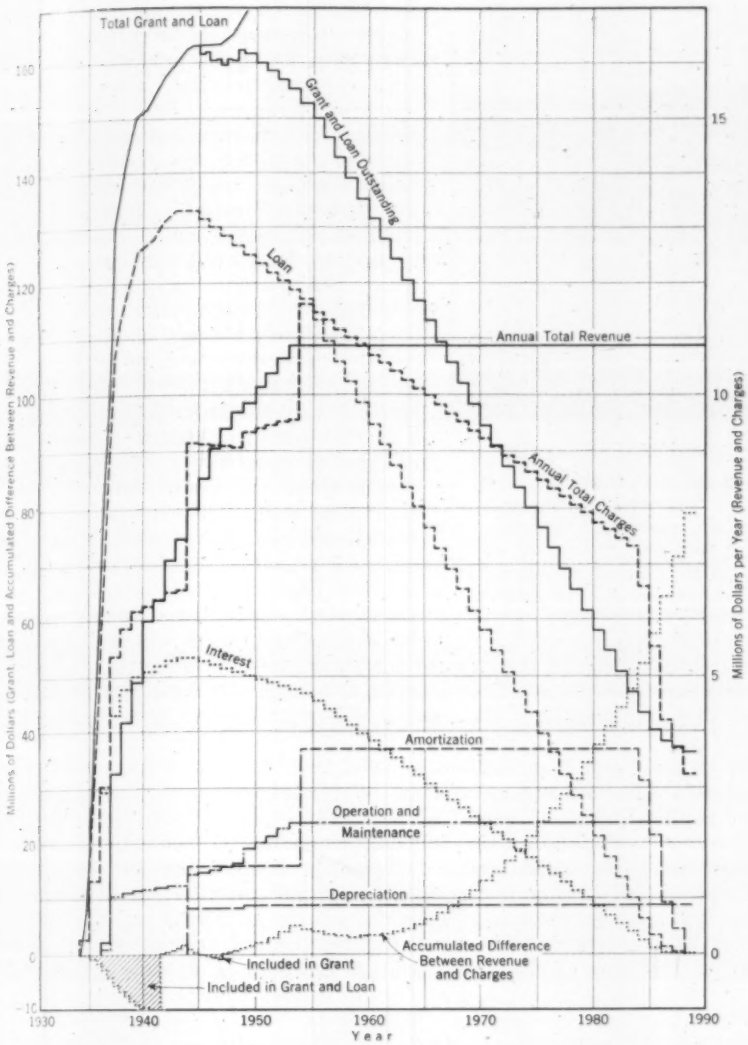


FIG. 1. GRAPHIC PRESENTATION OF A FINANCIAL ANALYSIS FOR THE CENTRAL VALLEY PROJECT

The Provisions of Title II of the National Industrial Recovery Act of 1933 Assumed

ment of that plan now being constructed as the Central Valley Project. In the first place a multitude of economic analyses were required in regard to capacity, location, and detailed design to determine the most economical plan among many for obtaining the objectives desired. In addition, many special economic studies were made—for example, on the "permissible annual charges for irrigation water," on the "permissible economic rate of irrigation development in California," and on many other phases too numerous to mention. A method of presenting such analyses graphically is shown in Fig. 1.

The task of greatest immediate importance was to formulate plans for a project that would take care of the acute problems of water shortage and inadequate water regulation in the Sacramento and San Joaquin valleys and the upper San Francisco Bay area—and one that could be financed. After consideration of many alternates, the most economic plan was finally formulated, and its cost carefully estimated, both as to capital and annual charges. The annual costs included fixed charges based upon different assumptions as to financing. Possible revenues from the project were also estimated—revenues from the sale of water based upon a unit price that studies indicated could be paid, and revenues from the sale of electric power based upon the estimated value of such power in the market. Costs and revenues were then compared. It was found that on the assumption of financing by bonds bearing interest at $4\frac{1}{2}\%$ to be retired in 40 years, the estimated annual cost would exceed the estimated revenues; but on the assumption of an interest rate of 3%, with a 50-year amortization period, estimated revenues would be sufficient to cover all carrying charges. Since the problem of financing was by far the most difficult one in getting the Central Valley Project started, many economic studies and financial analyses were made to show the respective merits of different schemes of financing.

In 1931 when the project was reported upon to the Legislature, it appeared that terms of financing presently available to the state would involve an over-all cost exceeding revenues. However, that did not necessarily mean that the project could not, at that time, have been economically justified as a state undertaking. It was recognized that the value of the indirect benefits would be large; and that if this value were taken into consideration, the benefits would far exceed the cost even under the most unfavorable terms of financing. Many of the indirect benefits were evaluated.

To cite but one example, a special economic study was made of the value of wholesaling and manufacturing trade between the industrial areas of Los Angeles and San Francisco and the Sacramento and San Joaquin valleys. In making this study as well as in investigating other special economic problems, the State Engineer employed a recognized expert, in this case Prof. George W. Dowrie of the Graduate School of Business at Stanford University. The survey revealed that the annual value of this business to the metropolitan centers amounted to over $700,000,000 with gross earnings accruing to wholesalers and manufacturers of about $185,000,000 annually; and furthermore, that the amount of this business depending for its continuance on the consummation of the Central Valley Project would total $85,000,000, with gross earnings to wholesalers and manufacturers of over $20,000,000 annually.

SIX-LANE HIGHWAY BETWEEN LOS ANGELES AND PASADENA

The cost of the Arroyo Seco Parkway, recently completed, came chiefly from gasoline tax funds, but contributions were also received from the WPA, PWA, and State Relief Administration. In accordance with the normal procedure adopted by the California State Highway Engineer's Office, economic and traffic analyses preceded the recommendation of the project.

BY-PASS WEIR ON SACRAMENTO FLOOD CONTROL PROJECT, CALIFORNIA

This project for control of floods on lower Sacramento and its main tributaries is being built at a cost of between fifty and sixty million dollars. It is jointly financed, one-third by the federal government, one-third by the State of California, and one-third by assessments on lands directly benefited. Under present federal flood-control laws, the cost of such projects may be borne entirely by the federal government if the "benefits to whomsoever they may accrue are in excess of the estimated costs, and if the lives and social security of people are otherwise adversely affected."

It was evident therefore that these interests as well as others benefited by the project could afford to meet any deficiency between total carrying charges and direct revenues from sale of water and electric power, by payments in the form of special taxes or in some other suitable form. However, there was the problem of determining how and from what source the necessary funds would be obtained; whether from the general taxes of the state or from special taxes on an improvement district organized especially to finance the project. Actually, although the project is being constructed as a federal enterprise, the machinery for financing and constructing it as a state undertaking was set up by the Central Valley Project Act of 1933.

FEDERAL INTERESTS AFFECTED

From its inception the project was considered to be of more than local interest—in fact, of material national concern. The features providing for improvement of navigation and flood control are of recognized federal interest under long-standing national policy and precedent. From the irrigation standpoint the project, designed for the relief and preservation of developed and producing lands and related developments, is considered to be an almost perfect example of the type of enterprise for which federal financing has been favored under policies expressed by Congress and federal officials. A direct contribution of federal funds for construction of the features providing for improvement of navigation and flood control, and federal financing of the irrigation features on an interest-free basis under the reclamation laws, were early considered to be clearly justified.

Because of its outstanding merit from all standpoints—engineering, economic, social—the project was approved and authorized as a federal undertaking and is now being constructed by the Bureau of Reclamation. But this authorization was not made until after several years of consideration during which many federal and state agencies participated in the most searching analysis given to any similar undertaking of recent years.

However, regardless of its outstanding social and economic benefits, the analyses proved that it was of unquestioned economic feasibility on the basis of federal financing as authorized; that is to say, that the revenues anticipated from the sale of water and electric power would be sufficient to return the cost of the project to the federal government and meet all other carrying charges. The final official finding on behalf of the federal government is contained in a so-called "Feasibility" report, made by Secretary of the Interior Harold L. Ickes on November 26, 1935, and approved by President Roosevelt on December 2, 1935. As to engineering and economic feasibility and financial soundness, the Central Valley Project has been recognized as preeminent among the many great projects of its type recently undertaken by the federal government.

There has been much difference of opinion even among engineers as to the justification for many of the great federal projects of recent years. It has been held by many that the costs of some of these far exceed any possible returns that the government can expect. On the other hand, many believe that these great projects should not depend for their justification upon a "dollar-and-cents" comparison of costs and revenues or evaluated benefits; that social and recreational benefits, for example, which are difficult or impossible to evaluate in terms of dollars, should also be considered.

Except in matters of emergency such as national defense, it would appear that before public funds are expended for public works construction the question should be considered: "Can this expenditure be afforded?" In other words, even assuming necessity or desirability, we must ask, "Can the people afford to pay the cost of the proposed improvement?" Whether or not the funds used come from general taxes or from tolls, in the last analysis it is the people's money that is being spent, and the amount available is not unlimited even with the taxing power of the federal government.

BENEFITS MUST OUTWEIGH COSTS

The public works engineer should never neglect economic considerations in connection with any public works development. In the first place, he should neither condone nor promote extravagant use of public funds. Therefore it should be his constant effort to plan, build, operate, and maintain public works at the least cost commensurate with the services required, regardless of whether the improvement is financed and supported by general tax funds or by special tax funds or tolls. In the second place, from an engineering standpoint, it would appear that the minimum requirement for justification of any public works development, unless it is found to be absolutely necessary regardless of cost or expense, should be a clear showing that the value of all benefits that can be definitely evaluated exceeds all costs. This is the criterion that federal flood control projects must meet under present federal legislation before being recommended for adoption by Congress. The justification of public works on any other basis is subject to too many uncertainties. It is objectionable in that it encourages the adoption of projects on political grounds, thus resulting in the wasteful use of public funds.

Economic studies to determine justification and to obtain the lowest cost are essential. For these purposes, the engineer should continue to promote the practice of economic studies for public works developments.

Sixty-Year Rainfall Record Analyzed

Results of Calculations Differ Somewhat from Those Secured Ten Years Ago Using 50-Year Record of Same Gage at Boston

By Hugh F. Kennison

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In the design of storm drains and spillways, the "rational method" of estimating flood flows from the rate of rainfall is a logical and popular procedure. However, the use of this method has been limited to relatively small watersheds for which the "time of concentration" is short. The reason for this is probably a lack of sufficient data on intensities of storms whose durations exceed about three hours.

The longer the period of record from a rain gage, the more reliable will be any predictions of flood flows made from the record. The general establishment of rain gaging stations in this country is comparatively recent, and therefore few records of long duration are available.

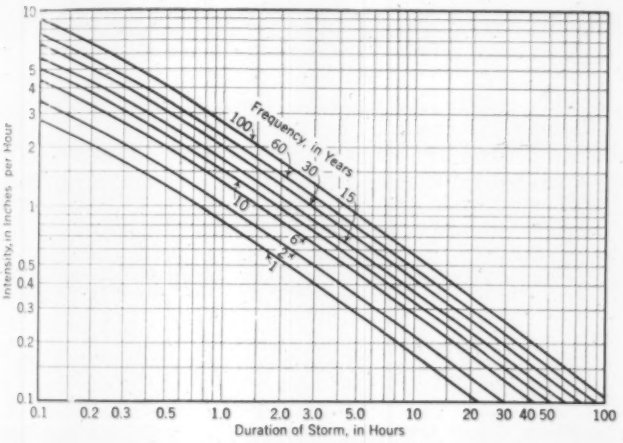

Fig. 1. Intensity of Precipitation at Boston, Mass., for Various Durations and Frequencies

Now there are a large number of rain gages in the United States, but unfortunately most of them are not of the recording type, and they are of little value in the preparation of intensity-duration curves. An exception is the 60-year record of the Chestnut Hill (Boston, Mass.) recording rain gage, a record which, if not the longest, is one of the longest in this country.

The present study deals with the relation between intensity of fall and frequency of recurrence for the excessive rainfalls of various durations found in this 60-year record from the Chestnut Hill Reservoir. A similar study of the 50-year record of the same rain gage was made 10 years ago by Charles W. Sherman, M. Am. Soc. C.E., and was described in the Transactions of the Society, Vol. 95 (1931), page 951. A comparison of the results of the two studies throws an interesting light on the influence of the longer record that is now available. The corresponding intensity-duration curves for 1, 10, and 100-year frequencies have been plotted from both studies.

In order that the results may be applied to extended drainage areas, durations up to 72 hours have been used in this analysis. Equations have been derived and curves plotted covering these durations for probable frequencies up to 100 years. The percentage deviation of the actual intensities from the computed values has been estimated for the 1, 10, 30, and 60-year frequency curves.

The rate of precipitation for any significant fractional period during a storm is seldom if ever constant. The peak rate may occur at any time during the period considered, and its relation to the average during the period may be quite variable. The rate of runoff produced by the rainfall in this period may therefore vary, depending upon the slope of the rain gage curve. It is reasonable to assume, however, that the rate of runoff caused by the rainfall during a given time will bear some definite relation, contingent upon the value of the runoff coefficient to the average rate of precipitation during the period. For practical reasons this assumption will be accepted, and only average rates over selected periods are considered in the succeeding study. Average rates are used as though the rainfall did occur at a constant rate equal to the average for the period of duration considered. This is the same procedure used by Mr. Sherman.

Principle of "Extended Duration"

A natural corollary to this method of procedure, according to Mr. Sherman, is the so-called "extended duration principle," which implies the computation of average rates of rainfall over periods that exceed the lengths of the storms. For example, in a storm that has lasted one hour and has produced 2 in. of rainfall, the average rate for one hour is 2 in. per hr and, by the "extended duration principle," for a two-hour period the average rate is 1 in. per hr. This procedure also is followed here.

The periods of duration used are those adopted by Mr. Sherman for the 50-year study. They were: 5, 10, 15, 20, 25, 30, 45, 60, 80, 100, 120, 150, and 180 minutes, and 4, 5, 6, 8, 10, 12, 15, 18, 21, 24, 30, 36, 42, 48, 54, 60, 66, and 72 hours.

In order to obtain an equation and a curve for the maximum average intensities of rainfall likely to occur in a period as short as one year, it was necessary to obtain the 60 highest rates in each of the assumed duration periods occurring in the entire 60 years of record, including those previously read by Mr. Sherman. All corrected rates of sufficient magnitude were properly combined with the data he accumulated. In all but two cases it was necessary to find intensities lower than Mr. Sherman's fiftieth highest in order to tabulate the 60 highest for the entire period (1879–1938).

Several types of empirical equations have been used to fit intensity-duration curve data. For rainfall durations of 5 to 120 minutes, Merrill M. Bernard, M. Am. Soc. C.E., in the Transactions of the Society (Vol. 96, 1932, page 592) used

$$i = \frac{K}{t + b} \qquad \text{.....(1)}$$

in which i is the intensity of rainfall in inches per hour; t is the duration in minutes; and K and b are constants.

The general form of equation adopted by the same authors for periods in excess of two hours is

$$i = \frac{K}{t^n} \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

where n is a constant exponent.

For rainfalls at Boston, Mr. Sherman suggested the more general form,

$$i = \frac{K}{(t+b)^n} \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

For most localities the relationship between intensity of rainfall and duration seems to follow a straight line

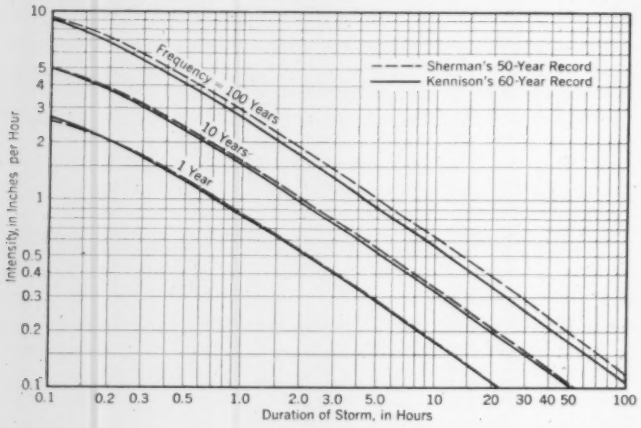

FIG. 2. RESULTS OF 50-YEAR AND 60-YEAR STUDIES COMPARED

when the points are plotted on log log paper, and Eq. 2 will fit the data quite well. The data from the 50-year Boston record, however, require the more general form of Eq. 3. The same form was found to be suitable and is adopted for the 60-year record.

Sherman found for the 50-year Boston record that the value of K was substantially constant for any one frequency. After analyzing the data for the 60-year record, the same assumption was made. Sherman found a simple exponential relation between the value of K and the frequency, but the data for the 60-year record are better fitted by the more complicated equation,

$$K = 15.6(1.6F - 0.6)^{0.22} \quad \ldots\ldots\ldots\ldots (4)$$

in which F is frequency in years.

The final empirical equation selected to represent the data for the 60-year record at Chestnut Hill is

$$i = \frac{15.6(1.6F - 0.6)^{0.22}}{(t+6)^{0.7}} \quad \ldots\ldots\ldots\ldots (5)$$

This relation is plotted on Fig. 1 for the 1, 2, 6, 10, 15, 30, 60, and 100-year frequencies.

DEVIATIONS FROM EMPIRICAL RELATIONS SMALL FOR HIGH-FREQUENCY STORMS

The percentage deviation of actual points from the corresponding points on the curves has been computed for the 1, 10, 30, and 60-year curves, and the results for the 1-year and 60-year frequencies are shown in Table I.

The maximum deviation for the one-year frequency curve is 3.15%; for the 10-year curve, 5.72%; and for the 30-year curve, 10.1%. The reliability of the curves decreases for the longer periods between recurrence. This emphasizes the value of long-term records. Actually the point that deviates 14.4% from the 60-year curve falls on the 100-year curve. With a longer period of record this point would not be in the data for the 60-year curve. There are, of course, no points for the 100-year curve in the 60-year record; its position is obtained entirely by extrapolation using Eq. 5.

TABLE I. DEVIATION OF RECORDED POINTS FROM POINTS COMPUTED FROM EQ. 5

DURATION (Minutes)	RECORDED INTENSITY (In. per Hr)	COMPUTED INTENSITY (In. per Hr)	DEVIATION (In. per Hr)	DEVIATION (%)
One-Year Frequency Curve				
5	2.95	2.91	−0.04	− 1.37
10	2.24	2.24	0.00	0.00
15	1.82	1.85	+0.03	+ 1.65
20	1.61	1.60	−0.01	− 0.62
25	1.38	1.41	+0.03	+ 2.13
30	1.23	1.27	+0.04	+ 3.15
45	0.97	1.00	+0.03	+ 3.00
60	0.83	0.83	0.00	0.00
80	0.67	0.69	+0.02	+ 2.90
100	0.60	0.60	0.00	0.00
120	0.54	0.53	−0.01	− 1.89
150	0.45	0.46	+0.01	+ 2.17
180	0.41	0.40	−0.01	− 2.50
Sixty-Year Frequency Curve				
5	9.15	8.00	1.15	−14.4
10	6.28	6.15	0.13	− 2.07
15	5.67	5.10	0.57	−10.00
20	4.95	4.37	0.58	−11.70
25	4.06	3.88	0.18	− 4.42
30	3.51	3.48	0.03	− 0.86
45	2.78	2.74	0.04	− 1.44
60	2.20	2.28	0.08	+ 3.64
80	1.73	1.90	0.17	+ 8.95
100	1.43	1.64	0.21	+12.8
120	1.28	1.45	0.17	+11.7
150	1.11	1.25	0.14	+11.2
180	1.12	1.10	0.02	+ 1.82
Hours				
8	0.61	0.57	0.04	− 7.03
15	0.39	0.36	0.03	− 8.33
30	0.24	0.23	0.01	− 4.35
54	0.15	0.15	0.00	0.00
72	0.11	0.12	0.01	+ 8.32

For comparison, curves for the 1, 20, and 60-year frequencies are shown on Fig. 2, both as computed from Eq. 5 and as obtained by means of Mr. Sherman's equation,

$$i = \frac{16F^{0.27}}{(t-7)^{0.7}} \quad \ldots\ldots\ldots\ldots (6)$$

These curves illustrate the effect of the storms of the last ten years. Their influence is negligible for the one-year frequency but becomes appreciable for the 60-year frequency. It is interesting also that a longer record tends to reduce the magnitude of the intensities of precipitation for each frequency curve, and this effect increases with the rarity of recurrence of the storm.

The results of this study were originally presented as a part of the writer's thesis in partial fulfillment of the requirements for the degree of bachelor of science in civil engineering from the Massachusetts Institute of Technology. The writer desires to express his appreciation to the Department of Civil and Sanitary Engineering of the Institute for permission to publish this paper. Acknowledgments are also gratefully made to Mr. Sherman, author of the first study, in furnishing data for the period from 1879 to 1928; to Samuel E. Killam, chief engineer and director of the Water Division, Metropolitan District Commission, for permission to use the charts from the Fitzgerald gage; and to Thomas R. Camp, M. Am. Soc. C.E., Associate Professor of Sanitary Engineering, Massachusetts Institute of Technology, for constructive criticisms and suggestions.

The Concept of Engineering—a Development of the Eighteenth Century

By W. E. Howland

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TWO vastly different systems of engineering development, Professor Howland shows, sprang up in France and England a century and a half ago. In one, the state-fostered education produced technical men of the caliber of Perronet, Prony, Coulomb, and Chezy; across the channel, the industrial revolution frowned on such teaching, but a few great practitioners such as Telford and Smeaton "just grew." Inevitably, there came a reaction to the sordid conditions produced in England by the industrial revolution, and in this reform the engineer was to take a part, emerging as the exponent in the economic world of a great ideal—service to mankind.

THE definition of engineering written into the charter of the Institution of Civil Engineers in 1827, commences with the oft-quoted words, "the art of directing the sources of power in nature for the use and convenience of man." This wording has been closely followed in most later definitions.

The three main elements of this definition may be related to three important streams of thought in the eighteenth century. Thus: The definition stresses the art, or science, of engineering as (1) an intellectual as well as merely manual control (rationalism), of the (2) resources of nature (economic realism), for the (3) service of mankind (humanitarianism). These ideas and sentiments brought in France the so-called "Enlightenment" which culminated in the Revolution of 1789, and in America the birth of our political democracy. The first two of these elements played a part in England in the industrial revolution, which, when its concomitant evils were corrected, did tend to the service of mankind by raising the standard of living.

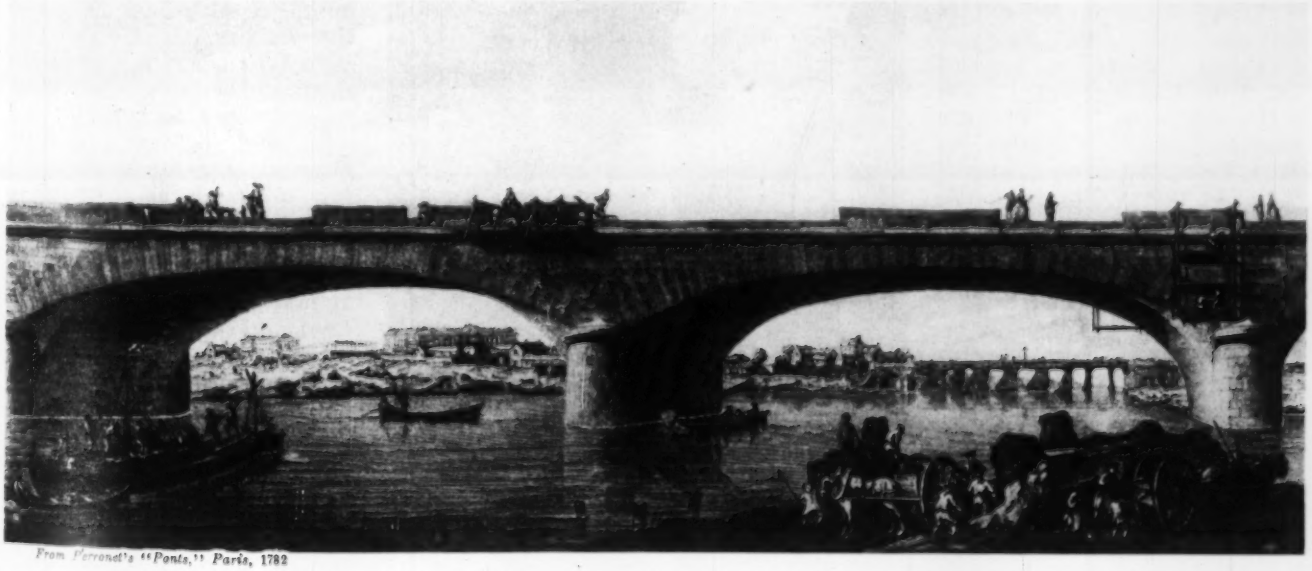
In eighteenth century France, an enthusiasm for individual freedom came to the fore in economic and political thinking. Medieval guilds were on the way out, and the monarchy was slowly being undermined. The last bridge built by the engineer Perronet was finished with stones taken from the demolished Bastille. It was to have been named for Louis XVI, but instead was called simply Pont de la Concorde, the royal head having been cut off in the interim.

Under onslaughts of men like Voltaire in France (or of quiet scholars like Gibbon in England) the church was losing its authoritative grip on the minds of men. The right to do, to say, to be what one liked in an ever-widening area of life was being recognized by an ever-widening circle of men. France's "Liberté, Égalité, and Fraternité" and America's "Life, Liberty, and the Pursuit of Happiness" were the standards under which intellectuals of high and low social position summoned the populace to destroy the bonds of the past and to enjoy what seemed to be the bounty of a beneficent future.

In all these doctrines and enthusiasms we may discern the eighteenth century idea of humanitarianism built into the concept of engineering and enshrined forever, we hope, in the concluding phrase of its latest, as well as its earliest definition, "for the benefit of man."

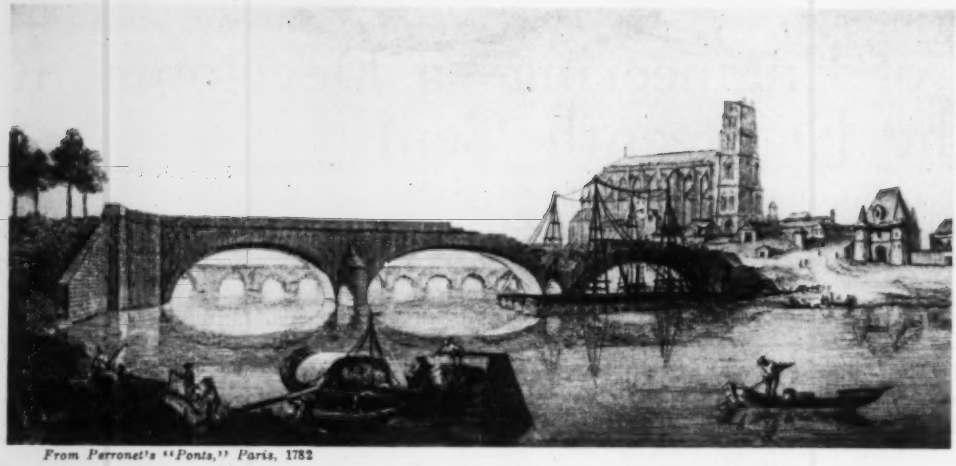
Although science at that time was still largely a hobby rather than a well-rewarded profession, many took the tool of the calculus, invented by Newton and Leibnitz, sharpened it, and applied it effectively. Hydraulics found itself so enriched by the work of the Bernoullis, of Pitot, LaPlace, Euler, and Chézy, that it was in its theoretical essentials almost complete when the century drew to a close.

In addition, popular science was progressing, especially in France. Almost immediately after its publication, Newton's *Principia* created a stir in the popular mind. Fontenelle, perpetual secretary of the French Academy



From Perronet's "Ponts," Paris, 1782

Pont De Neuilly Under Construction, 1773, One of Perronet's Great Works



From Perronet's "Ponts," Paris, 1782

ANOTHER OF PERRONET'S BRIDGES UNDER CONSTRUCTION
Pont de Mantes, 1764

of Sciences, helped with his *Conversations on the Plurality of Worlds*, the first work of popular science in any language. And in his *History of Oracles* he turned the scientific searchlight upon the "impostures of the ancient Greek oracles." The effect, although cleverly disclaimed, was to undermine confidence in the theological impostures of the church.

The spirit of the leaders of thought in the eighteenth century in France cannot be described without mentioning Voltaire. According to Durant, "Italy had its Renaissance, Germany its Reformation, but France had Voltaire." Like engineering itself, he was the product of a blending of a passion for scientific truth and profound practical interest in the welfare of mankind.

It may seem a far cry from Voltaire to engineering. He was not an engineer, scarcely even a scientist, but in identifying him with the century, I am in a word giving the tempo, recalling the influences sweeping through men's minds and inducing them to utilize their intellectual powers for the solution of vast every-day practical human problems. And that is engineering.

Thus it does not seem strange that it was in eighteenth century France that the "profession" of engineering arose; in fact it may be dated from the year 1747, when a commission was given to Jean Rodolphe Perronet (1708–1794) charging him "with the direction and supervision of surveyors and designers of plans and maps of the roads and highways of the realm and of all those who are appointed and nominated to such work; and [this is important] to instruct the said designers in the sciences and practices needful to fulfilling with competency the different occupations relating to said bridges and highways." Thus was inaugurated by a central government the first engineering school (later known as the École des Ponts et Chaussées) and the first systematic course of training, without which engineering would have remained a journeyman's trade.

Eighteenth century roads in France were vastly superior to those in Britain for two reasons—trained engineers were available to build them and they were built by the government with money collected by taxation, and not by the toll system as in England.

Because of this encouragement to the engineers and the engineering schools by the government, the progress of engineering in France far outstripped that of any other country in those early years. The School of Mines was established in 1778, and the École Polytechnique in 1795—long before formal engineering instruction in Great Britain was even thought of.

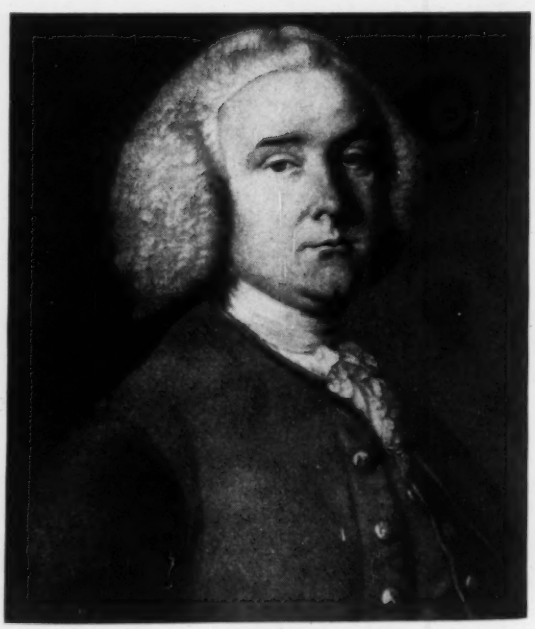
To the faculties of these engineering schools were called, and in them were trained, many of the most brilliant engineers of the time: Perronet, Prony, Coulomb, Chézy, and Gauthy. Men like LaGrange, LaPlace, DeLorme, and Berthollet, though not engineers, served on their faculties. This was a time when professors were not always ridiculed—"brain trust" would not then have been a term of reproach.

VIRTUE IN THE PRACTICAL

A third idea is implied in the concept of engineering—a recognition of the importance of the practical, material activities of man in obtaining the good things of nature. It is a little difficult for us in this machine age to realize the grip the classical tradition once had upon education, and the revulsion men felt toward servile, that is, serviceable occupations, or the contempt for "debasing" meaning basic activities of life.

With this fear of contaminating the soul by vulgar practicality went an entirely misleading conception of economic reality. In the eighteenth century dawned the recognition that the material wealth of mankind is not a matter of bookkeeping and financial wizardry or of military power. For the race as a whole, the algebraic sum of debits and credits is zero and the time integral of the world's military wealth approaches negative infinity. In part, wealth is coal, iron, and food from the earth, and houses, clothing, tools, roads, bridges, aqueducts, buildings, and machinery. These physical things minister mightily to man's needs, and therefore it is not beneath his dignity to produce them.

This common-sense notion was at first anything but popular in England, then still a nation of traders and soldiers, rather than of manufacturers. The greatest political figure at the beginning of the eighteenth century was the Duke of Marlborough, "the greatest in war, in avarice, and in treachery." But in bribery he had to take second place to Robert Walpole, who became the first Prime Minister in 1714



From Smeaton's "Edystone Lighthouse," London, 1791

PORTRAIT OF JOHN SMEATON (1724–1792), EARLY ENGLISH ENGINEER

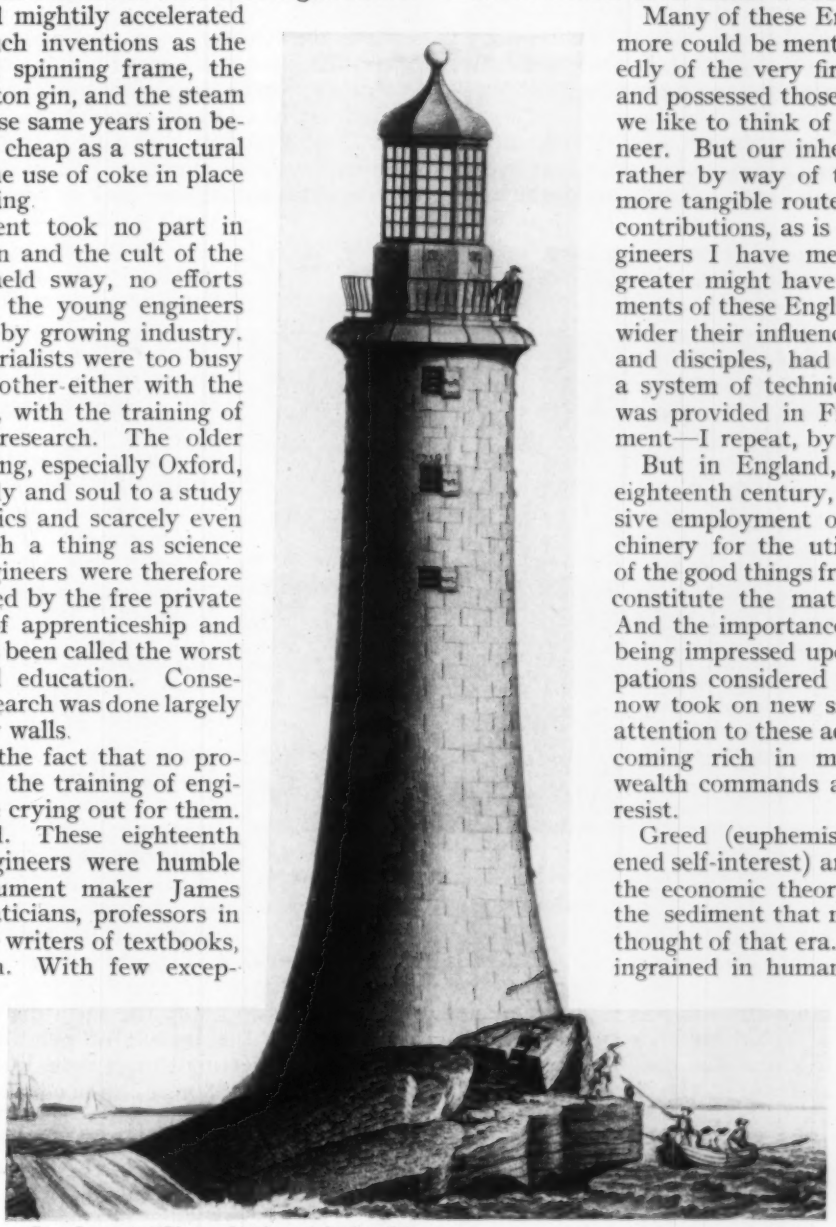
and ruled for 21 years—the man who is remembered for his cynical epigram, "Every man has his price." It was the time of the East India Company. It was the time of the South Sea Company—great stock speculation schemes and frauds made possible by the popular misconceptions of economic reality—which incidentally have not yet disappeared from the world.

As the new leaders of expanding industries grew wealthy and were able to buy their way into society, their "honor" slowly rose, though it scarcely approached that of the landed aristocracy. Engineers also rose slowly—very slowly—in esteem, and one (Thomas Telford) long after the turn of the century, attained the honor of a memorial statue in Westminster Abbey. How lonely he must feel there, how dull he must find the company, surrounded as he is by soldiers, lawyers, and kings!

It was in England, however, that the new type of struggle for the good things of nature, as developed by the mind and hand of man, really started with the industrial revolution. This scheme of industrial organization was originated and mightily accelerated as the result of such inventions as the spinning jenny and spinning frame, the power loom, the cotton gin, and the steam engine. During these same years iron became abundant and cheap as a structural material through the use of coke in place of charcoal in smelting.

As the government took no part in technical instruction and the cult of the classically useless held sway, no efforts were made to train the young engineers so urgently needed by growing industry. Most private industrialists were too busy making money to bother either with the welfare of workmen, with the training of engineers, or with research. The older institutions of learning, especially Oxford, were committed body and soul to a study of the ancient classics and scarcely even recognized that such a thing as science existed. British engineers were therefore self-trained or trained by the free private enterprise system of apprenticeship and pupilage—which has been called the worst enemy of technical education. Consequently scientific research was done largely outside of university walls.

Notwithstanding the fact that no provision was made for the training of engineers, the times were crying out for them. And they appeared. These eighteenth century British engineers were humble men like the instrument maker James Watt—not mathematicians, professors in technical schools, or writers of textbooks, as were the French. With few exceptions, as for example the architect Christopher Wren, they were of an entirely different sort—masons, wheelwrights, and mechanics with little more than a common-school education. They were, however, engineers in the original sense of the word, that is, ingenious men. They were earnest and sincere in their devotion to their tasks and amazingly gifted by nature; but unlettered and servile, poorly paid, and accepting the treatment accorded the lowliest of servants.



From Smeaton's "Edystone Lighthouse." London, 1791

EDYSTONE LIGHTHOUSE, MONUMENT TO SMEATON
South Elevation of Epochal English Structure Completed in 1759

GOOD ENGINEERS DESPITE LITTLE TRAINING

One of the earliest of these justly famous British engineers, James Brindley, started as a millwright. He built many miles of the first and most successful canals in England for the wealthy Duke of Bridgewater, who paid him $5.00 a week for his services. (Some of his pay, due him at his death, was withheld from his widow.)

John Smeaton, though better educated than Brindley, entered the profession by the route of instrument making. We honor him for many achievements but remember him mainly for the Edystone Lighthouse, the first one built to stand. Around the top of it are cut these words, "Except the Lord build the house, they labor in vain that build it." A true engineer builds a lighthouse with as much reverence as he builds a church.

Many of these Englishmen—and many more could be mentioned—were undoubtedly of the very first rank in intelligence and possessed those qualities of character we like to think of as typical of the engineer. But our inheritance from them is rather by way of tradition than by the more tangible route of their own written contributions, as is true of the French engineers I have mentioned. How much greater might have been the accomplishments of these Englishmen and how much wider their influence on their colleagues and disciples, had they been trained by a system of technical education such as was provided in France by the government—I repeat, by the government.

But in England, at the close of the eighteenth century, was begun the extensive employment of power-operated machinery for the utilization and creation of the good things from nature that largely constitute the material wealth of man. And the importance of this creation was being impressed upon men. Lowly occupations considered for ages as degrading now took on new significance. By giving attention to these activities, men were becoming rich in money—and monetary wealth commands a respect that few can resist.

Greed (euphemistically called enlightened self-interest) and its canonization in the economic theory of laissez faire, were the sediment that muddied the stream of thought of that era. Now greed is deeply ingrained in human nature and its ascendency in the eighteenth century was by no means unique. But the philosophy that emphasizes avarice as the primary motive of man and holds that, in the mass, it is automatically self-correcting and worthy

to be relied upon without restraint and without plan as the director of an entire economic order (or disorder)—this stems from the eighteenth century. It may be regarded as a sort of cancerous overgrowth of liberalism itself.

ENGINEERING VERSUS LAISSEZ FAIRE

And herein lies a paradox, for the concepts of laissez faire and of engineering are the very opposites of each other and both are the natural children of the times:

Engineering is:	Laissez faire is, in the theory at least:
(1) control of natural resources,	(1) absence of control but, in practice in the eighteenth century and early nineteenth, it was exploitation of natural and human resources,
(2) by scientific methods,	(2) by any method or no method,
(3) for all mankind.	(3) for the profit of the ruling minority.

The absurdity of the anarchic egoism of laissez faire was to become increasingly manifest. Free economic enterprise showed itself to be not free but monopolistic; not economic but wasteful; not enterprising but reactionary.

H. G. Wells remarks of eighteenth century England:

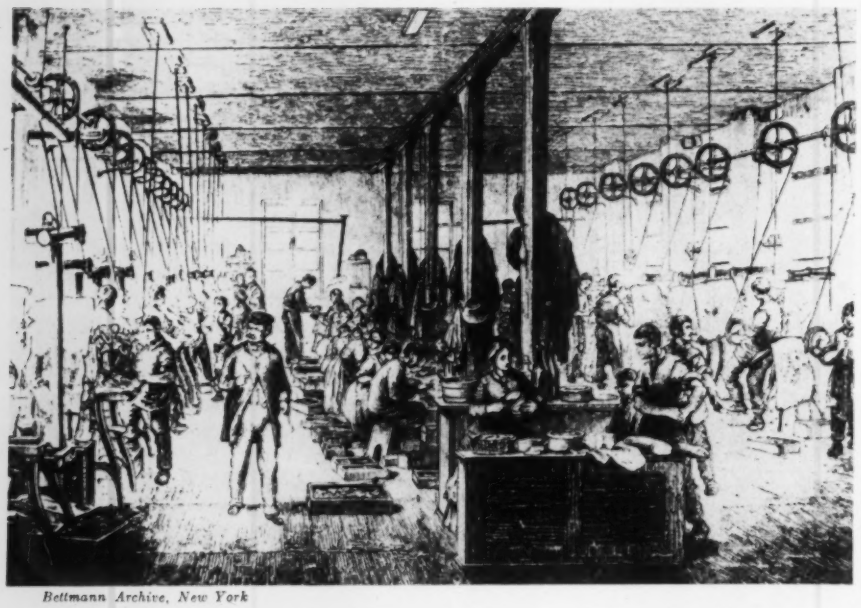
"Private enterprise which meant in practice that everyone was entitled to get everything he could out of the business of the community, reigned supreme . . . . There is no recognition that it is wrong to be an unproductive parasite on the community and still less that a financier or a merchant can be overpaid for his services to mankind . . . . lords and gentlemen who grabbed the people's commons, assumed possession of the mines under their lands, and crushed down the yeomen farmers and peasants to the status of pauper laborers, had no idea they were living anything but highly meritorious lives."

As a result, "small cultivators and peasants ruined and dislodged by the Enclosure Acts drifted toward the new manufacturing regions, and there they joined the families of the impoverished and degraded craftsmen in the factories. Great towns of squalid houses came into existence. Ugly great factories grew up, built as cheaply as possible, to hold as many machines and workers as possible. Around them gathered the streets of workers' homes, built at the cheapest rates, without space, without privacy, barely decent, and let at the utmost rent that could be exacted."

I might add here that Adam Smith, in his *Wealth of Nations*, of 1776, reflecting the capitalistic views of the times, urged that no taxes be collected to support any form of public institution of learning whatsoever.

So the canals and roads and lighthouses, the perfected steam engine of Watt, the spinning jenny, the new methods for production of iron, the many other technical developments, and the mass production methods that they made possible, did not immediately, or without untold suffering, result in benefit to all mankind. Instead, the benefits were intercepted by the bigger private owners. "Often," says Wells, "the community was injured to the profit of the ruling minority." And judging by the writings of other authors, Wells has not overstated the case.

Thus the century closed in England with poverty and misery for vast numbers of a submissive populace; and in France, where the elastic limit of submission was exceeded, with a bloody revolution. But in the longer view these afflictions and catastrophes—these failures of economic systems, whether of an indifferent capitalism or of a despotic feudalism—may be regarded as but temporary setbacks to an otherwise continuous process of amelioration of the condition of mankind. And even a contemporary sufferer of the worst of these evils, the great French liberal, Condorcet, caught between the millstones of revolution and reaction at the end of the century, could write while awaiting arrest and execution, "Living in this happy age and being witnesses of the last efforts of ignorance and of error, we have seen reason emerge victorious from this struggle, so long and difficult, and we can at last cry out, 'Truth has conquered and mankind is saved!' "



Bettmann Archive, New York

INTERIOR OF AN ENGLISH TYPE FOUNDRY, MIDDLE OF NINETEENTH CENTURY
Unregulated Private Enterprise Caused Bad Working Conditions in Factories

ENGINEERING WAY IS KEY TO PROGRESS

Now it is just possible that I am prejudiced in favor of the profession of engineering, to which I am proud to belong, but it seems to me that, in a real sense, truth conquered and mankind was saved when the profession of engineering was born. Not that the present narrowly limited professions of engineering alone can save the world—I do not claim that. But I do believe—call it faith, if you like—that the eighteenth-century engineers hit upon the true method of progress.

Progress is to apply the scientific method to practical problems for the benefit of mankind—not any or no methods, not letting things slide, but scientific methods; not solely to problems of an academic nature but also to the practical problems of the times crying out for solution; not for narrowly selfish or merely pecuniary purposes but for the benefit of the human race. And I look forward with all the optimism of the eighteenth-century liberals to the extension of this method, effort, and purpose to all the areas of experience despite the evidences of ignorance and of error that still abound.

Storage Basins as a Supplement to Storm Sewer Capacity

By JOHN A. ROUSCULP

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ENGINEER IN CHARGE OF SEWER DESIGN, DIVISION OF ENGINEERING, CITY OF COLUMBUS, OHIO

THE use, under certain circumstances, of small storage basins to supplement sewer capacity is proposed here by Mr. Rousculp as a possibly economical alternative to larger sewers. An analysis of the runoff problem in terms of accumulated volume as related to runoff rate leads to a short discussion of possible types of storage structures, costs, and practical applications of the storage principle. Points for possible discussion are presented in conclusion.

WHEN it is considered that storm sewers are typically designed for capacities that will be equalled or exceeded on an average of but once in perhaps ten years and then possibly for only a few minutes, the possibility that considerable saving may be realized by utilizing storage to supplement smaller sewer capacities becomes evident. To properly analyze this possibility in any given case, it is desirable to substitute a concept of accumulated volume in cubic feet per acre for the more usual idea of rate of runoff in cubic feet per second per acre. In addition the engineer will need a practical design procedure for determining the details of location, volume, and type of basin, and its relative economy.

The initial step is the conversion of the rainfall intensity rates for selected frequencies into terms of accumulated volumes. A 10-year frequency curve and 30% runoff coefficient are assumed for demonstration purposes. A typical analysis is given in Table I.

The volumes given in Col. 8 of Table I are Col. 7 volumes corrected or adjusted for an assumed 10-min inlet time, since Col. 7 volumes correspond in effect to a 5-min inlet time. The correction is accomplished by plotting Col. 7 values five times, each succeeding curve being plotted accumulatively upon the preceding ones with the starting points of each separated by 2-min intervals. This results in a composite curve of corrected volume for 5 acres from which the corrected values on a basis of one acre, as given in Col. 8, are computed by dividing the value at 5-min intervals by 5.

A similar analysis, for informative purposes, is made for 5-year, 2-year, 1-year, $^1/_4$-year, and $^1/_8$-year frequencies with the results plotted in Fig. 2. (The rainfall curves used for this analysis are shown in Fig. 1.)

Lines for rate of flow per acre are drawn also on Fig. 2. The purpose of these lines is to indicate the storage necessary to supplement any rate of flow per acre that may be selected. The example in the figure shows the storage requirement between the 10-year curve and the 0.5 cu ft per sec rate of flow to be about 730 cu ft per acre. To adjust to another constant coefficient of runoff, for example, 0.4, the total storage will be $(^4/_3 \times 1{,}680) - 950 = 1{,}290$ cu ft. Also, the slope of the steepest portion of each curve corresponds to the maximum rate in cubic feet per second per acre for design. The maximum rate for the 10-year curve is thus about 1.3 cu ft per sec per acre, and for the 1-year curve, about 0.8. Since the storage requirements derived from Fig. 1 are for initial inlet areas—in this study 10-min inlet areas—and since a number of such areas are combined into larger areas and correspondingly longer periods of concentration, it follows that there will be a corresponding reduction in storage requirements per acre.

The amounts of such reductions are next calculated for 10-year rainfall, with slopes of $s = 0.001$, $s = 0.003$, and $s = 0.010$, and for 1-year rainfall with a slope of $s = 0.003$. For this phase of the illustration, values of area, distance, and time between points of collection are based upon an assumed layout. This layout, with area, runoff, time, and distance relations, is shown in Fig. 3. For convenience, the area is made up of 100-acre plots which in turn are made up of 5-acre blocks, arranged four in a row to make up 20-acre divisions. One set of typical computations is given in Table II. The results of these are plotted in Fig. 3.

When the time intervals between points of concentration have been computed, tabulations are made by combining arithmetically and successively the accumulated volumes, as in Col. 8, Table I. This determines the volume per acre for larger areas. In combining the volumes, each successive starting time is separated from that of the previous combination in accordance with

TABLE I. TEN-YEAR RAINFALL RATES IN TERMS OF ACCUMULATED VOLUME PER ACRE

Time (Min) (1)	Rate (In. per Hr) (2)	Total Depth (In.) (3)	Depth Increment (In.) (4)	Vol. Increment for 1 Acre (Cu Ft) (5)	Vol. Increment for 30% Runoff (Cu Ft) (6)	Col. 6 Vol. Accumulated (Cu Ft) (7)	Col. 7 Vol. Corrected for 10-Min Inlet Time (Cu Ft) (8)
5	5.60	0.47	0.47	1,700	510	510	180
10	4.90	0.82	0.35	1,270	380	890	540
15	4.36	1.09	0.27	980	294	1,184	920
20	3.92	1.30	0.21	760	228	1,412	1,200
25	3.57	1.48	0.18	650	195	1,607	1,440
30	3.25	1.62	0.14	510	153	1,760	1,630
35	2.96	1.72	0.10	360	108	1,868	1,770
40	2.71	1.81	0.09	320	96	1,964	1,880
45	2.50	1.87	0.06	220	66	2,030	1,970
50	2.30	1.91	0.04	150	45	2,075	2,040
55	2.12	1.94	0.03	110	33	2,108	2,090
60	1.97	1.97	0.03	110	33	2,141	2,120
65	1.82	1.97*	....	...	...	....	2,140

* No increase beyond 60 min.

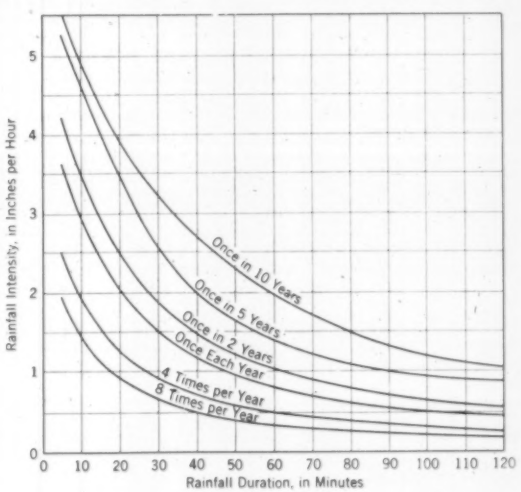

FIG. 1. INTENSITY-DURATION CURVES FOR RAINFALLS OF VARIOUS FREQUENCIES (COLUMBUS, OHIO)

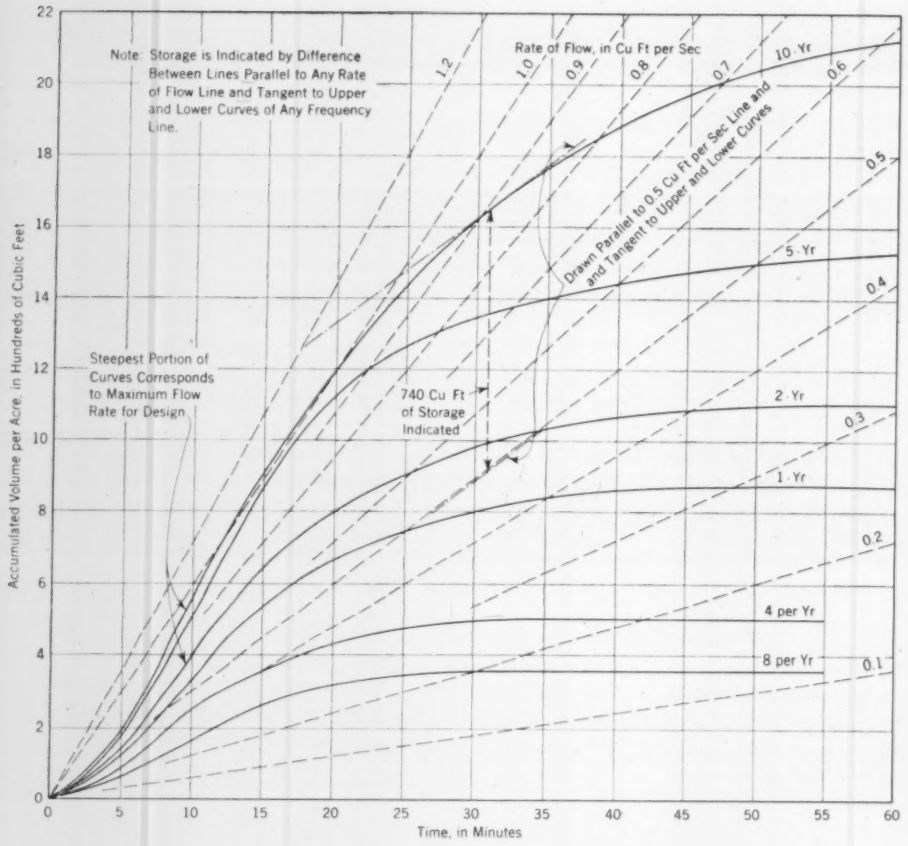

FIG. 2. ACCUMULATED VOLUME OF RUNOFF PER ACRE, FOR VARIOUS RAINFALL FREQUENCIES (RUNOFF 30%)
For Initial or 10-Min Inlet Areas

the time intervals computed. For example, starting with rates per acre representing 5 acres, for the first combination—the time interval being 1.8 min—the 5-min value is added to the value adjusted to 6.8 min by proportion; then the 10-min value is added to the adjusted 11.8 min volume, etc. Although this combining can be done graphically, the arithmetical procedure is used here to avoid the possible inconsistencies of scaling.

After three such successive combinations, the rates per acre representing 20 acres have been determined. Similarly, using 20-acre rates for four successive combinations, the 100-acre rates are determined, and the same process is applied to obtain 400-acre and 1,200-acre rates. The results of the tabulations for the case of 10-year rainfall and 0.003 slope are plotted in Fig. 4. After the results of all tabulations are plotted, the storage volumes required per acre for various corresponding rates of outlet capacity are determined, as shown in the example of Fig. 4. These volumes are listed in Table III.

Attention is drawn to the fact that the maximum runoff rate per acre (given in Col. 9 of Table III) is taken from the computations dealing with combinations of accumulated volumes previously described. Comparison of these rates with rates corresponding to time area relations in Fig. 3 shows differences which are greatest for flat slopes and large areas. Such differences are due to a shortcoming inherent in the usual method of computing runoff. This is that the rate corresponding to the total time of concentration of the area is multiplied by the area, whereas actually the maximum runoff may occur when a portion of the total area is concentrating at a higher rate, corresponding to the concentrating time of that portion. Hence, with the usual method, the actual maximum rate can only be determined by making a series of computations involving various trial proportions of the total area.

Storage volumes required per acre for 10-year rainfall with 0.003 slope, and for 1-year rainfall with 0.003 slope, are plotted against rates of outlet capacity in Fig. 5(*a*). To show the effect of slope on storage volume required, the values for slopes 0.001 and 0.010 and an area of 1,200 acres are shown by dotted lines in this figure.

The reduction in storage requirements corresponding to increase in area is apparent. Values from Fig. 5(*a*) are given in Fig. 5(*b*), with storage plotted against area to illustrate relation of storage decrease to area increase; Fig. 5(*c*) gives results of calculations (based on Fig. 4) of approximate storage requirements for various percent-

TABLE II. AREA, RUNOFF, TIME, AND DISTANCE RELATIONS FOR AN ASSUMED LAYOUT—10-YEAR RAINFALL, 30% RUNOFF, AND 0.003 SLOPE

Area (Acres) (1)	Distance (Hundreds of Ft) Increment (2)	Distance (Hundreds of Ft) Accumulated (3)	Time (Min.) Increment (4)	Time (Min.) Accumulated (5)	*Runoff Rate (Cu Ft per Sec per Acre) (6)	Total Runoff (1) × (6) (Cu Ft per Sec) (7)	Velocity (Ft per Sec) (8)
5				10	1.46		
	3.63	3.6	1.8			7.3	3.4
10				11.8	1.41		
	3.63	7.2	1.6			14.1	4.0
15				13.4	1.36		
	3.63	10.9	1.4			20.5	4.3
20				14.8	1.30		
	6.0	16.9	2.2			26	4.6
40				17.0	1.25		
	6.0	22.9	1.7			50	5.8
60				18.7	1.21		
	6.0	28.9	1.6			73	6.3
80				20.3	1.17		
	6.0	34.9	1.5			94	6.7
100				21.8	1.14		
	14.5	49.4	3.5			114	7.0
200				25.3	1.06		
	14.5	63.9	3.0			213	8.2
300				28.3	1.01		
	14.5	78.4	2.7			302	9.0
400				31.0	0.96		
	14.5	92.9	2.5			384	9.7
500				33.5	0.92		
	14.5	107.4	2.4			462	10.0
600				35.9	0.88		
	29.0	136.4	4.7			526	10.4
800				40.6	0.81		
	29.0	165.4	4.5			650	10.9
1,000				45.1	0.75		
	29.0	194.4	4.3			750	11.3
1,200				49.4	0.70		
	29.0	223.4	4.2			840	11.6
1,400				53.6	0.66	925	

* From 10-year rainfall frequency curve.

ages of runoff on a 100-acre area, for 10-year rainfall and a 0.003 slope. In considering the possible economy of the use of storage in any specific example, the storage requirements may be taken from Fig. 5.

For comparative purposes, types of storage basins contemplated are separated into three general groups:

1. The open or uncovered type with unpaved bottom and slopes. Structural work in this type would be confined principally to sewer arrangements for discharging and receiving flow. A basin constructed by building a dam across a natural ravine falls into this class.
2. Types similar to (1) but with paved bottom or paved slopes or both.
3. Covered basins of reinforced concrete. These may range from an enlarged conduit section for use with small drainage areas, to an extensive slab and column arrangement for larger areas.

The depth of a basin should in general be governed by the size of the incoming sewer, and should be somewhat less than this sewer's diameter, unless conditions permit upstream surcharge. However, the depth may be greater than this by an amount approximately equal to the drop from the inlet to the outlet sewer, if such additional fall is available or can be provided. It is probable that for smaller areas, with correspondingly smaller sewers, sufficient surcharge might be allowed to furnish a storage depth of at least 5 ft.

A possible form of storage basin and a few general principles of operation are illustrated in Fig. 6. Obviously, the simplest form is that in which the inlet and outlet conduits connect directly to the basin without the use of a through channel or an outlet chamber. If a through channel, connecting inlet and outlet conduits, with provision to permit flow to pass to and from storage is added, the channel may be placed slightly below the basin bottom so that the water spreads out into storage with almost every storm. By providing sides to the through channel the flow may be confined until the capacity of the outlet conduit is exceeded. In this case, the sides constitute weirs over which the excess flow passes to the basin. Flap gates on the side of the channel then pass the flow from the basin back into the channel as the water level in the channel recedes. Such a basin may be further elaborated by division into a number of sections with overflow weirs at various elevations to permit only such portions of the basin to come into operation as the magnitude of any particular storm may require.

To prevent surcharge in the outlet conduit, a sluice gate may be provided for regulating the flow from the outlet basin. Also, for experimental purposes, the gate might be closed to determine the total runoff from the tributary area by measurement of volume in the basin and of the flow over the emergency overflow weir.

Some provision for unusual storms should be considered. From a study of existing Columbus, Ohio, rainfall records it is estimated that the 50-year storm exceeds the 10-year storm by about 30%. On this basis, a 30% to 50% excess capacity above the normal storage level should provide for the emergency. Obviously, a sewer system without supplemental storage basins might experience similar heading up during the unusual storm.

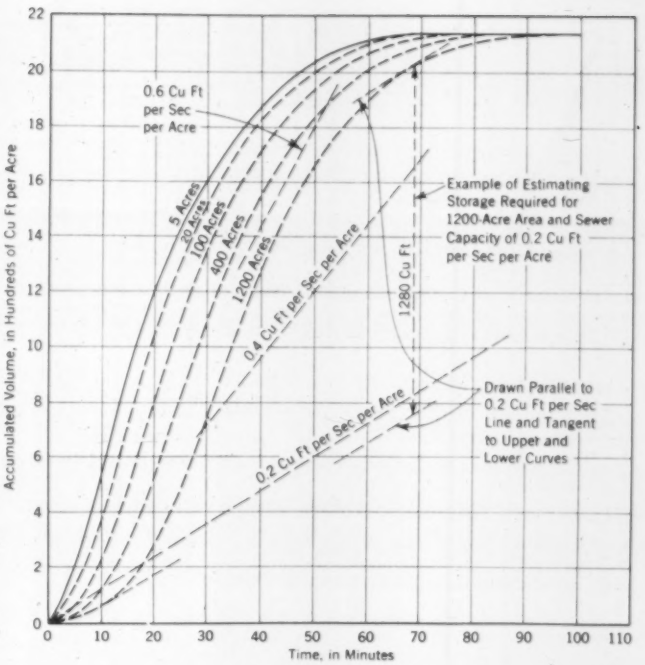
Accumulated Volume, in Hundreds of Cu Ft per Acre
Time, in Minutes
0.6 Cu Ft per Sec per Acre
5 Acres
20 Acres
100 Acres
400 Acres
1200 Acres
0.4 Cu Ft per Sec per Acre
0.2 Cu Ft per Sec per Acre
1280 Cu Ft
Example of Estimating Storage Required for 1200-Acre Area and Sewer Capacity of 0.2 Cu Ft per Sec per Acre
Drawn Parallel to 0.2 Cu Ft per Sec Line and Tangent to Upper and Lower Curves

FIG. 4. ACCUMULATED VOLUME DIAGRAM FOR VARIOUS AREAS (FOR 10-YEAR RAINFALL, 30% RUNOFF, AND 0.003 SLOPE)

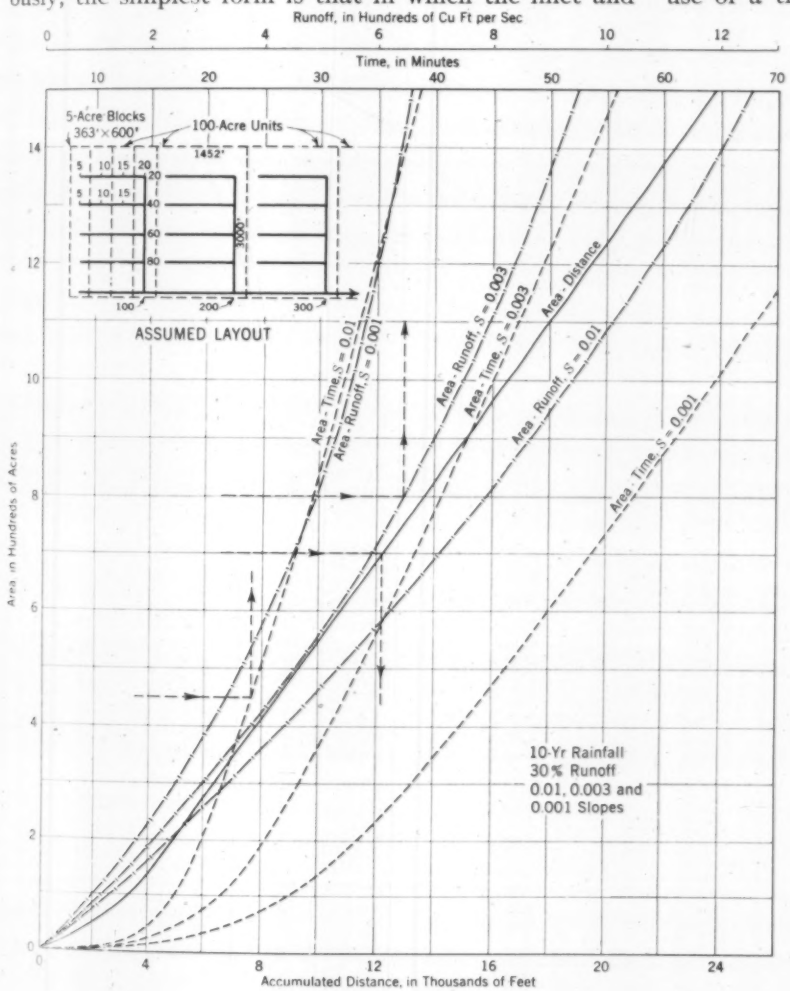
Runoff, in Hundreds of Cu Ft per Sec
Time, in Minutes
5-Acre Blocks 363'×600'
100-Acre Units
1452'
ASSUMED LAYOUT
Area - Time, S = 0.01
Area - Runoff, S = 0.01
Area - Runoff, S = 0.003
Area - Time, S = 0.003
Area - Distance
Area - Runoff, S = 0.01
Area - Time, S = 0.001
10-Yr Rainfall
30% Runoff
0.01, 0.003 and
0.001 Slopes
Area, in Hundreds of Acres
Accumulated Distance, in Thousands of Feet

FIG. 3. AREA, RUNOFF, TIME, AND DISTANCE RELATIONS FOR ASSUMED LAYOUT

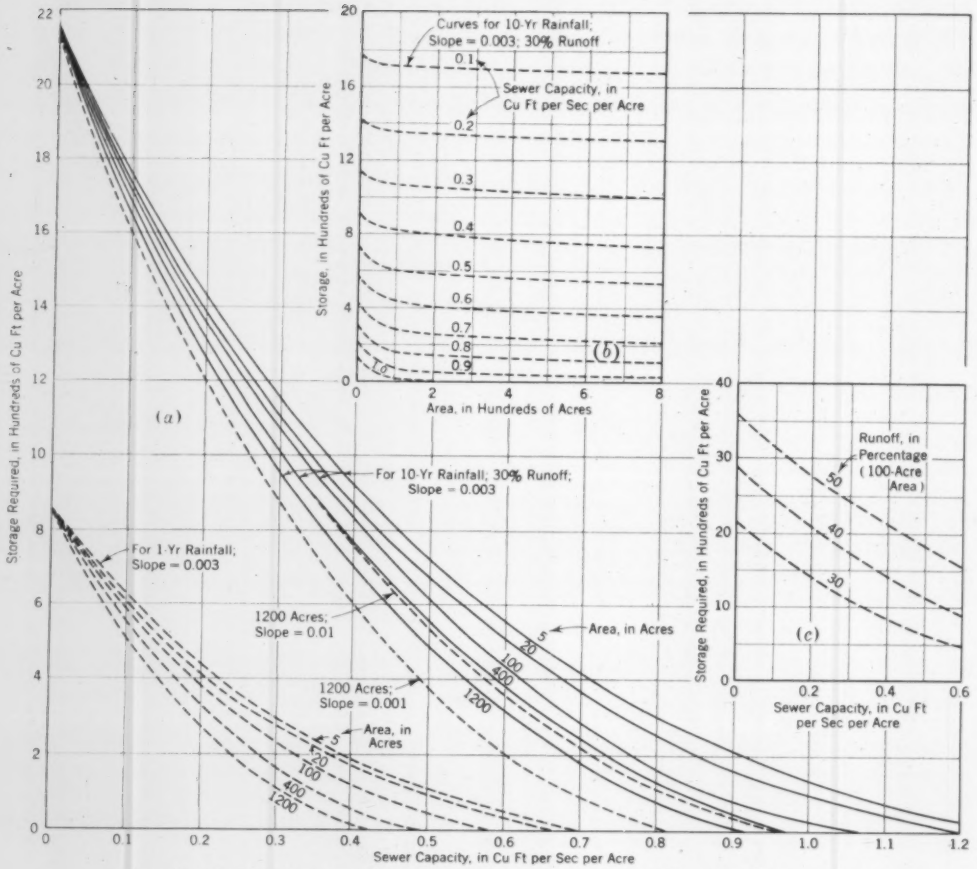

FIG. 5. RELATIONS OF STORAGE REQUIREMENTS AND SEWER CAPACITIES

The cost of storage per cubic foot may vary between wide limits because of such factors as cost of land, depth of excavation, and nature of storage structure. Where cost of land, excavation, and structural work is relatively low, the cost of open unpaved storage may be as low as 4 to 5 cents per cu ft. At the other extreme, underground reinforced concrete chambers may raise the cost to as much as 40 or 50 cents per cu ft.

It is roughly estimated that the range of cost for Type 1 storage is from 5 to 10 cents per cu ft; for Type 2, 10 to 20 cents; and for Type 3, 20 to 50 cents. This includes an allowance of about one-third the total area for slopes and boundaries. The cost of maintenance and cleaning would, of course, depend on the type of basin used, but since such cost is not expected to prove seriously large, its consideration may well be left to actual operation experience.

TABLE III. STORAGE REQUIRED TO SUPPLEMENT SEWER FLOW CAPACITY FOR VARIOUS AREAS AND CAPACITIES WITH 30% RUNOFF

Sewer Flow Capacities*.....	Area (Acres)	Storage Volume (Cu Ft per Acre)						†Maximum Runoff Rate (Cu Ft per Sec per Acre)
		0.1	0.2	0.4	0.6	0.8	1.0	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
10-year rainfall, 0.001 slope	5	1,760	1,440	920	550	300	130	1.26
	20	1,720	1,380	860	480	220	60	1.12
	100	1,690	1,320	780	380	120	0	1.00
	400	1,640	1,260	700	300	50	0	0.91
	1,200	1,600	1,200	600	200	0	0	0.80
10-Year rainfall, 0.003 slope	5	1,760	1,440	920	550	300	130	1.26
	20	1,730	1,400	870	500	240	80	1.20
	100	1,710	1,360	820	440	170	20	1.06
	400	1,680	1,310	760	380	120	0	0.96
	1,200	1,650	1,280	690	300	80	0	0.91
10-Year rainfall, 0.01 slope	5	1,760	1,440	920	550	300	130	1.26
	20	1,740	1,410	880	510	250	90	1.20
	100	1,720	1,380	840	460	200	30	1.12
	400	1,700	1,340	800	410	150	0	1.00
	1,200	1,690	1,320	750	360	100	0	0.96
1-Year rainfall 0.003 slope	5	630	440	190	70	0	0	0.70
	20	610	410	180	20	0	0	0.67
	100	580	380	120	0	0	0	0.58
	400	560	330	50	0	0	0	0.49
	1,200	520	280	10	0	0	0	0.43

* In cubic feet per second per acre.
† Taken from accumulated volume computations.

The data given in Fig. 5 provide a useful basis for general cost comparisons covering the range of areas and capacities in the assumed problem. Such comparisons demonstrate that storage might well be considered in relief sewers, especially if cheap land or park area is available. For areas of uncertain future development, provision for possible future storage might be considered to supplement sewers constructed to serve more immediate needs. The economy of storage increases with the flatter slopes, for storage costs decrease as sewer costs increase.

There are several features of the storage method that deserve to be emphasized in conclusion:

1. What is its dependability in comparison with the provision of equivalent sewer capacity?
2. Its consideration in connection with any design problem results in a more complete analysis of the storm runoff.
3. It provides additional facilities for securing runoff data.
4. It may aid the acquisition of low-lying areas proposed for park or playground purposes by combining recreational use with storm storage use.
5. There is the possibility of setting aside, when subdividing, a central area in each block or a central block in a number of surrounding blocks, for combined recreational and storage purposes.
6. Problems incident to silting and to freezing weather deserve further consideration.

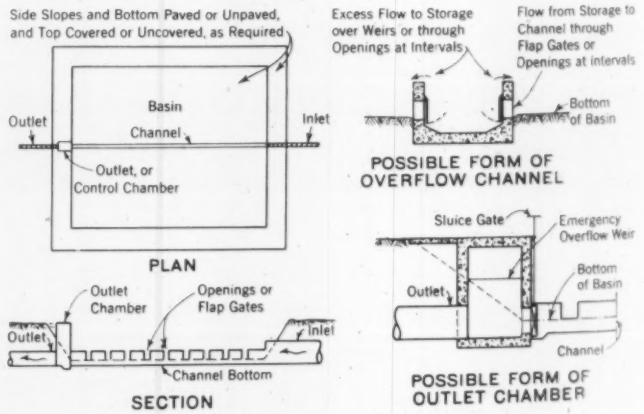

FIG. 6. A SUGGESTED FORM OF STORAGE BASIN

ENGINEERS' NOTEBOOK

Ingenious Suggestions and Practical Data Useful in the Solution of a Variety of Engineering Problems

Pre-Cast Concrete Piles for Canal Walls at Long Beach, Calif.

By JOHN W. B. BLACKMAN, M. AM. SOC. C.E.

FORMERLY CITY ENGINEER AND DIRECTOR OF PUBLIC SERVICE, LONG BEACH, CALIF.

IN the residential district of Long Beach (Calif.) known as Naples, a real estate company in 1906 built a number of canals adjacent to the lots, so that property owners could have easy access to small boats. The bulkhead walls consisted of wood sheet piles, secured to anchors and faced with about 4 inches of portland cement concrete.

These walls remained in place until the earthquake of March 10, 1933, at which time large parts of them collapsed. The adjacent area had by then been well built up with residences ranging from the moderate to the expensive, and as time went on the condition of the unsupported canal banks (of dredged sand fill) became more and more dangerous to them.

Whilst the original wall structure was built by the then property owners before the district became annexed to

DILAPIDATED CANAL WALLS AT LONG BEACH AND (AT RIGHT) WORK IN PROGRESS ON NEW WALLS

the City of Long Beach, it was quite obvious that the property owners could not afford to bear the entire expense of a new wall. A property owners' association was therefore formed; financial aid was secured from both the city of Long Beach and Los Angeles County; and the new construction was ultimately approved as a WPA project.

It was decided that the most suitable type of wall design for WPA work would be the use of pre-cast concrete sheet piles tied back to anchor piles. Labor for pile casting, form setting, steel fabrication, backfilling and sidewalk construction was to be provided by the WPA, while hauling of piles from the casting yard to the site, driving of piles, placing of anchor rods, and casting of the coping was to be undertaken by contract.

Figure 1 shows the general design used throughout the 11,273 lin ft of wall. A total of 5,995 piles was required, the number and size of the various types being as follows:

Sheet piles, 2 ft 4 in. by 10 in., lengths 22 to 26 ft . .	4,824
Anchor piles, 1 ft 3 in. by 1 ft 3 in., lengths 22 to 26 ft . .	1,138
Corner piles, various sizes	33

Vertical reinforcing for the 24-ft sheet piles consisted of $^{7}/_{8}$-in. round bars; for the 26-ft piles the bar diameter was increased to 1 in., and for the 22-ft piles it was decreased to $^{3}/_{4}$ in. Horizontal bars, $^{3}/_{8}$ in. in diameter, were spaced as shown in Fig. 1. The anchor piles were designed with six vertical bars $^{3}/_{4}$ in. in diameter, held with $^{5}/_{16}$ in. wire. Concrete was a $6^{3}/_{4}$-sack mix with a minimum compressive strength of 2,500 lb at 28 days.

STEEL CHANNELS HOLDING INFLATED RUBBER TUBES PROVIDED GROUT-TIGHT FORMS FOR THE JOINTS

Owing to the fact that no additional protection against the corrosion of the concrete and steel from the sea air and sea water other than the thickness of the concrete itself could be used, the steel was kept 3 in. from the face of the piles. (Experience on the southern California coast has shown that the life of unprotected concrete piles with steel only 2 in. from the face is limited to from 10 to 15 years when exposed to sea air and sea water.) Every care was used in grading the mineral aggregates and in regulating the amount of water used, so as to obtain as dense a concrete as possible. Electric vibrators were used for compaction.

For the work of laying platforms, setting forms, fabricating the reinforcement, and pouring the concrete, an average of 200 men daily were employed, and an average of 25 piles per day were cast.

A PORTION OF THE FINISHED WALL

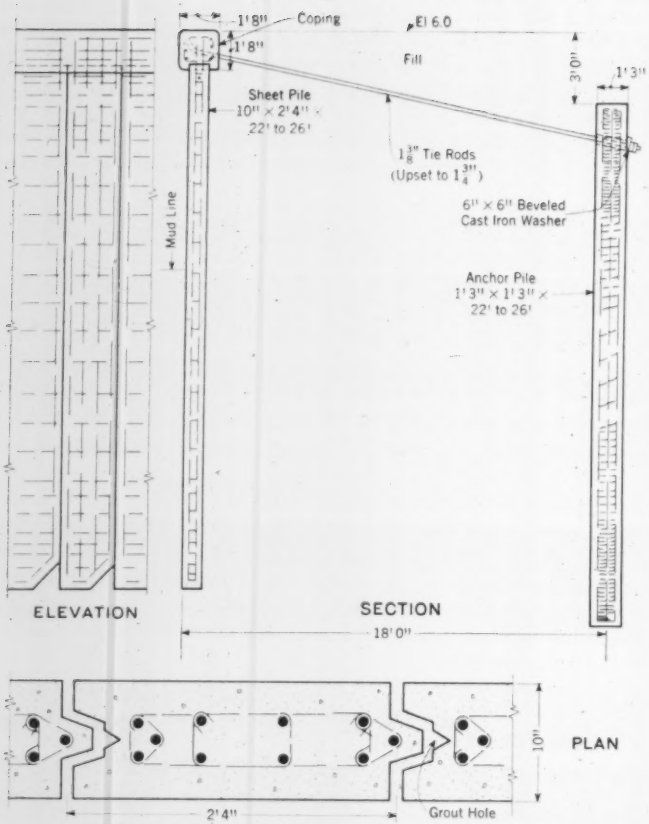

FIG. 1. DESIGN OF SHEET AND ANCHOR PILES

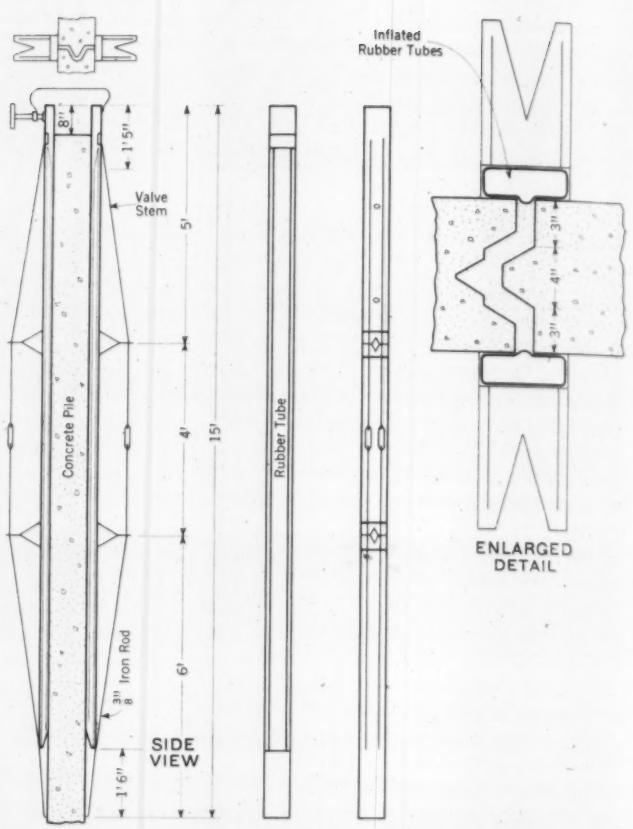

FIG. 2. STEEL FORMS WITH INFLATED TUBES TO HOLD GROUT

Experience on other concrete sheet-pile bulkheads had forcibly demonstrated to the writer that where sand fill was used behind such piles a leakage of sand would occur through the tongue-and-groove joints in spite of the fact that they were driven closely together. To obviate this trouble an additional space in the groove was made so as to give more room for the grout to be poured (see detail in Fig. 1). The next problem was to develop a method to prevent the grout from escaping from the sides of the joints. After experimenting, the following system was used: At each joint and on both sides of the wall, a trussed steel channel tapered at the bottom (Fig. 2) was driven into the ground opposite the joint and as close to it as possible, and clamped at the top. Inside each of these channels was a rubber tube, and when the channels were in place the tubes were inflated, causing them to press closely against the face of the joints, thus holding the grout from escaping where the piles were not driven close enough together to hold the grout of themselves. The removal of the forms left a neat joint, concave in shape. Out of nearly 6,000 joints grouted, only a few leaks were discovered, and these were easily repaired.

Piles were lifted from the tiers on which they had been cast by a specially designed beam with four equalized lifting points. They were then transferred by truck to barges and towed to the pile driver. As rapidly as the sheet and anchor piles were driven, the placing of the $1^3/_8$-in. tie rods followed. The latter were coated with asphalt and wrapped to prevent rusting. Backfilling was then completed by WPA labor and the new fill was settled by jetting. This method, incidentally, revealed any joints that had not been fully grouted. Finally a 6-ft concrete sidewalk was laid and a non-corrosive iron railing installed on the coping. Total cost of the work, including labor and material furnished by the WPA, was about $585,000. Col. D. H. Connolly was the Chief Administrator for the WPA, and the writer is indebted to him and to all other WPA officials for their cooperation throughout the job.

Simplified Stress Analysis of Three-Ring Brick Sewers

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ENGINEER IN DIVISION OF DESIGN, CITY OF PITTSBURGH, PA.

THE work involved in the analysis of stresses in a circular sewer section is considerable. To reduce the labor required by the usual analyses, the writer has derived the formulas presented here. It should be stated at once, however, that these are applicable only to a three-ring brick circular sewer which is fixed at the springing line.

For the derivation of the formulas, the method for indeterminate structures, as described in Vol. 1 of *American Sewerage Practice*, by Metcalf and Eddy, was used. However the formulas for crown thrust and crown bending moment as given there are rewritten in the following forms:

$$H_c = \frac{n\,\Sigma my - \Sigma m \Sigma y}{(\Sigma y)^2 - n\Sigma y^2} \qquad (1)$$

and

$$M_c = \frac{\Sigma my \Sigma y - \Sigma m \Sigma y^2}{n\Sigma y^2 - (\Sigma y)^2} \qquad (2)$$

in which

n = number of voussoirs in the half-arch.

m = bending moment at any point in the half-arch due to external loads only, the half-arch considered fixed at the springing line.

y = vertical distance of any point on the center line of the ring from the crown as origin.

For the computation of the crown bending moment and crown thrust in Cols. 3 and 4, respectively, of Table III, the half-arch is divided into five equal voussoirs as shown in Fig. 1 and is also considered fixed at the springing line. All vertical and horizontal loads, bending moments, and all properties of the arch are in terms of D, the inside diameter of the arch ring; d, the height of the earth above the crown; and w, the weight of earth per cubic foot.

The vertical load used in the formulas is the equivalent of that included between vertical planes touching the outside of the masonry. The horizontal load is based on an angle of repose equal to approximately 30°; therefore, the intensity of the horizontal earth pressure can be taken as one-third of the intensity of the vertical pressure at any point. The dead load of the masonry ring is included in Table I, Col. 8.

After the crown force and crown moment have been determined by the use of Eqs. 1 and 2, each half of the arch is considered a cantilever acting under a known system of loads. The total moment M at any voussoir center is then computed from the general formula

$$M = m + M_c + H_c y$$

TABLE I

Voussoir No. (1)	x (2)	y (3)	y^2 (4)	Horizontal Projection (5)	Vertical Projection (6)	Vertical Load Intensity (7)	Total Vertical Load + 0.2380 Dw (8)
1	$.0782D$	$.0062D$	0	$.1545D+.1674$	$.0245D+.0265$	$dw+.0062Dw+.0067w$	$.1545Ddw+.0010D^2w+.1674dw+.2400Dw+.0011w$
2	$.2270D$	$.0545D$	$.0030D^2$	$.1394D+.1510$	$.0711D+.0770$	$dw+.0545Dw+.0590w$	$.1394Ddw+.0076D^2w+.1510dw+.2544Dw+.0089w$
3	$.3536D$	$.1465D$	$.0215D^2$	$.1106D+.1198$	$.1106D+.1198$	$dw+.1465Dw+.1587w$	$.1106Ddw+.0161D^2w+.1198dw+.2732Dw+.0190w$
4	$.4455D$	$.2730D$	$.0745D^2$	$.0711D+.0770$	$.1394D+.1510$	$dw+.2730Dw+.2957w$	$.0711Ddw+.0194D^2w+.0770dw+.2800Dw+.0228w$
5	$.4939D$	$.4218D$	$.1779D^2$	$.0245D+.0265$	$.1545D+.1674$	$dw+.4218Dw+.4569w$	$.0245Ddw+.0103D^2w+.0265dw+.2604Dw+.0121w$
		$\Sigma y = .9020D$	$\Sigma y^2 = .2769D^2$				

Voussoir No. (1)	Horizontal Load Intensity (9)	$\Delta x_2-\Delta x_1$ (10)	$\Delta y_2-\Delta y_1$ (11)	Total Horizontal Load (12)	Sum of Vertical Loads (13)
1	$3333dw+.0021Dw+.0022w$	$.1488D$	$.0484D$	$.0082Ddw+.0001D^2w+.0088dw+.0001Dw+.0001w$	$.1545Ddw+.0010D^2w+.1674dw+.2400Dw+.0011w$
2	$3333dw+.0182Dw+.0197w$	$.1266D$	$.0919D$	$.0237Ddw+.0013D^2w+.0257dw+.0028Dw+.0015w$	$.2939Ddw+.0086D^2w+.3184dw+.4944Dw+.0100w$
3	$3333dw+.0488Dw+.0529w$	$.0919D$	$.1266D$	$.0369Ddw+.0054D^2w+.0400dw+.0117Dw+.0063w$	$.4045Ddw+.0247D^2w+.4382dw+.7676Dw+.0290w$
4	$3333dw+.0910Dw+.0986w$	$.0484D$	$.1488D$	$.0464Ddw+.0127D^2w+.0504dw+.0274Dw+.0149w$	$.4756Ddw+.0441D^2w+.5152dw+1.0476Dw+.0518w$
5	$3333dw+.1406Dw+.1523w$	0	$.1564D$	$.0515Ddw+.0217D^2w+.0558dw+.0470Dw+.0255w$	$.5001Ddw+.0544D^2w+.5417dw+1.3080Dw+.0639w$

Voussoir No. (1)	Sum of Horizontal Loads (14)	m (16)	m' (15)	Σmy (17)
1	$.0082Ddw+.0001D^2w+.0088dw+.0001Dw+.0001w$			
2	$.0319Ddw+.0014D^2w+.0345dw+.0029Dw+.0016w$		$.0234D^2dw+.0001D^2w+.0253Ddw+.0357D^2w+.0002Dw$	$.0013D^2dw+.0000D^4w+.0014D^2dw+.0018D^2w+.0000D^2w$
3	$.0688Ddw+.0068D^2w+.0745dw+.0146Dw+.0079w$		$.0401D^2dw+.0012D^2w+.0435Ddw+.0629D^2w+.0015Dw$	$.0093D^2dw+.0002D^4w+.0101D^2dw+.0144D^2w+.0002D^2w$
4	$.1152Ddw+.0195D^2w+.1249dw+.0420Dw+.0228w$		$.0459D^2dw+.0031D^2w+.0497Ddw+.0723D^2w+.0037Dw$	$.0299D^2dw+.0012D^4w+.0324D^2dw+.0467D^2w+.0015D^2w$
5	$.1667Ddw+.0412D^2w+.1807dw+.0890Dw+.0483w$		$.0401D^2dw+.0050D^2w+.0435Ddw+.0569D^2w+.0059Dw$	$.0630D^2dw+.0040D^4w+.0683D^2dw+.0961D^2w+.0048D^2w$
				$\Sigma my = .1035D^2dw+.0054D^4w+.1122D^2dw+.1590D^2w+.0065D^2w$

$$\Sigma m = .3458D^2dw+.0152D^2w+.3746Ddw+.5330D^2w+.0186Dw$$

$$H_c = \frac{5(.1035D^2dw+.0054D^4w+.1122D^2dw+.1590D^2w+.0065D^2w)-(.3458D^2dw+.0152D^2w+.3746Ddw+.5330D^2w).902D}{(.902D)^2-5(.2769)D^2}$$

$$H_c = Dw(.3601d+.0233D+.5504)+w(.3908d+.0275)$$

$$M_c = \frac{.9020D(.1035D^2dw+.0054D^4w+.1122D^2dw+.1590D^2w+.0065D^2w)-.2769D^2(.3458D^2dw+.0152D^2w+.3746Ddw+.5330D^2w)}{5(.2769D^2)-(.902D)^2}$$

$$M_c = D^2w(.0042d-.0012D+.0073)+Dw(.0044d+.0007)$$

TABLE II

Vous. No.	ΣH (2)	ΣV (3)	Thrust (4)	Shear (5)
(1)	Condition: D = 2 ft, d = 10 ft, w = 100 lb			
Crown	....	0	1233	0
1	25.3	524.9	1268	334
2	99.6	1009.5	1472	380
3	218.5	1413.5	1710	296
4	373.8	1698.7	1910	12
5	553.2	1831.7	1918	385
	Condition: D = 4 ft, d = 5 ft, w = 100 lb			
Crown	....	.....	1176	0
1	21.0	490.4	1215	315
2	84.7	959.6	1404	368
3	192.4	1377.5	1671	278
4	343.2	1703.6	1910	28
5	530.1	1887.7	1978	338
	Condition: D = 5 ft, d = 4 ft, w = 100 lb			
Crown	....	.....	1213	0
1	20.3	498.6	1255	310
2	82.8	984.9	1455	375
3	192.5	1432.8	1740	280
4	352.5	1796.5	1990	25
5	558.0	2013.3	2095	338
	Condition: D = 6 ft, d = 10 ft, w = 100 lb			
Crown	....	.....	2968	0
1	67.0	1437.2	3560	920
2	269.1	2795.1	4120	1060
3	605.3	3974.3	4830	825
4	1070.0	4852.9	5430	90
5	1633.8	5290.1	5520	1000
	Condition: D = 10 ft, d = 10 ft, w = 100 lb			
Crown	....	.....	4778	0
1	91.9	1962.5	4920	1250
2	370.6	3838.8	5660	1480
3	845.9	5500.7	6650	1160
4	1516.2	6765.8	7500	180
5	2353.5	7401.1	7720	1240

TABLE III

Vous. No. (1)	$H_c y$ (2)
1	$.0022D^2dw+.0001D^2w+.0024Ddw+.0034D^2w+.0002Dw$
2	$.0196D^2dw+.0013D^2w+.0213Ddw+.0300D^2w+.0015Dw$
3	$.0528D^2dw+.0034D^2w+.0573Ddw+.0806D^2w+.0040Dw$
4	$.0983D^2dw+.0064D^2w+.1067Ddw+.1503D^2w+.0075Dw$
5	$.1519D^2dw+.0098D^2w+.1648Ddw+.2322D^2w+.0116Dw$
Sp. L.	$.1801D^2dw+.0117D^2w+.1954Ddw+.2752D^2w+.0138Dw$

	Bending Moment (3)
Crown	$D^2w(.0042d-.0012D+.0073)+Dw(.0044d+.0007)$
1	$D^2w(.0064d-.0011D+.0107)+Dw(.0068d+.0009)$
2	$D^2w(-.0004d+.0016)+Dw(.0004d+.0020)$
3	$D^2w(-.0065d+.0009D-.0107)+Dw(-.0071d+.0030)$
4	$D^2w(-.0069d+.0008D-.0133)+Dw(-.0074d+.0028)$
5	$D^2w(.0066d-.0008D+.0117)+Dw(.0072d+.0010)$
Sp. L.	$D^2w(.0187d-.0124D+.0397)+Dw(.0204d-.0010)$

	Thrust (4)
Crown	$Dw(.3601d+.0233D+.5504)+w(.3908d+.0275)$
1	$Dw(.4013d-.2911D+4.0457)+w(1.0258d-12.5310)$
2	$Dw(.4507d-.3463D+4.8859)+w(1.2592d-15.2726)$
3	$Dw(.4802d-.3744D+5.7381)+w(1.6788d-19.2699)$
4	$Dw(.6107d-.4731D+6.3175)+w(1.4396d-18.3326)$
5	$Dw(.5941d-.4381D+6.5692)+w(1.4563d-18.6505)$
Sp. L.	$Dw(.5001d+.0544D+1.3080)+w(.5417d+.0639)$

	Shear (5)
Crown	0
1	$Dw(.1245d-.0800D+.8600)+w(.1900d-2.4500)$
2	$Dw(.1300d-.0813D+1.0509)+w(.2492d-3.0686)$
3	$Dw(.0998d-.0575D+0.7592)+w(.2217d-2.5414)$
4	$Dw(.0281d-.0806D+0.7833)+w(.0879d-2.5632)$
5	$Dw(.1029d-.1155D+1.4305)+w(.3910d-4.5170)$
Sp. L.	$Dw(.1934d-.0179D+0.4614)+w(.2101d-0.0208)$

This formula is elaborated for particular voussoirs in Col. 3 of Table III.

From the fact that the form of the equations for thrust and shear is known, formulas for these quantities at the center of each voussoir can be obtained by solving five simultaneous equations to determine coefficients of the d, D, and w terms. Preliminary to securing these equations, a corresponding number of hypothetical conditions are established, as shown in Table II. Columns 2 and 3 are obtained by means of formulas listed in Table I, Cols. 13 and 14, respectively. From Cols. 2 and 3, a force diagram is carefully drawn to a large scale for every condition; and the thrust and shear values given in Cols. 4 and 5 of Table II are determined graphically for each voussoir center.

The simultaneous equations for the desired coefficients of d, D, and w are now set up with the unknowns A, B, C, D, and E representing these coefficients.

$$\begin{aligned}
20A + 4B + 2C + 10D + E &= R_1 \\
20A + 16B + 4C + 5D + E &= R_2 \\
20A + 25B + 5C + 4D + E &= R_3 \\
60A + 36B + 6C + 10D + E &= R_4 \\
100A + 100B + 10C + 10D + E &= R_5
\end{aligned}$$

The values for R_1, R_2, ... R_5 are taken from Cols. 4 and 5 of Table II. The solutions obtained are incorporated in the various formulas for thrust and shear listed in Table III, Cols. 4 and 5.

It should be borne in mind that these formulas are applicable when the loading is symmetrical, when the sewer shell is considered fixed at the springing line, and when the trench material is of such nature that the horizontal load is approximately one-third the vertical load. The second condition usually prevails whenever the brick sewer is in rock cut with the rock extended to the springing line. The last condition exists when the backfill is more or less granular in nature.

When yielding soil is encountered, the section shown in Fig. 2 is very often used. The stiffness of that part

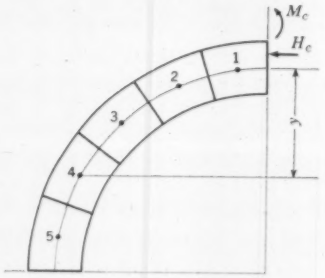

FIG. 1.

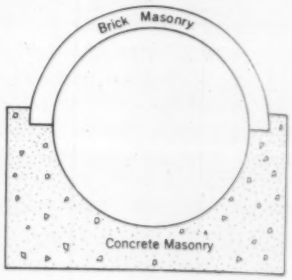

FIG. 2.

of the sewer shell below the springing line is so great in comparison with that of the upper ring, that the former acts in the same manner as the abutment of a concrete arch bridge, that is, it absorbs all the moment transmitted to it from the upper ring. For this reason, when the stresses involved in this type of sewer section are analyzed, the upper arch is considered fixed at the ends. The formulas derived here are therefore applicable.

These formulas can also be used in the stress analysis of any small circular masonry ring whose shell thickness is equivalent to that of the three-ring brick and whose loading and foundation conditions are the same as those specified here.

Our Readers Say—

In Comment on Papers, Society Affairs, and Related Professional Interests

Bridge Building in the Early Days

DEAR SIR: The article entitled "The Horse-and-Buggy Days of Bridge Building" by H. S. Tullock, in the September issue, mentions the Kansas City Bridge on which Octave Chanute and George S. Morison were engineers. This brings up an interesting story told me in 1909 while we were sinking piers on the Atchafalaya River. An old sand hog was telling an experience with either Chanute or Morison which went about as follows.

At one time the swing pier of the Hannibal Bridge (the Kansas City Bridge) showed signs of uneven settlement, and it was decided to go down and reinforce the foundation. A ring caisson was built, and excavation under air pressure was begun. After the workmen had gotten some distance below the bottom of the pier, they commenced to be fearful of the safety of the caisson which was groaning and working all the time.

It was finally decided to send for either Morison or Chanute, I forget which, and try to get him to agree that a proper depth had been reached at which to seal the caisson. After an answer from the engineer saying that he would be there the next day had been received, a dozen large flat stones were taken down into the caisson and carefully planted under from one to three feet of sand in the bottom of the caisson, and a distinguishing mark was lightly scratched on the side of the caisson opposite each rock.

The engineer arrived and went down into the working chamber, and a man was provided with an iron rod and a sledge hammer to make the soundings for the chief engineer. The resident engineer suggested, "Mr. Morison, shall we make a sounding right here?" when he was opposite one of the marks identifying a buried rock. "No," replied Mr. Morison, "move it over here," and shifted the location about three feet. The result was that they sounded entirely around the working chamber and missed every one of the rocks that had been planted there for the benefit of the chief engineer. However, much to the relief of the entire force, the chief engineer decided that they had gone deep enough and could seal up the caisson.

I thought this comment on one of the old-timers might be interesting to readers of CIVIL ENGINEERING.

E. N. NOYES, M. Am. Soc. C.E.
Dallas, Tex. *Consulting Civil Engineer*

Counting Cocoanuts by "Common Sense"

DEAR SIR: Recalling the engineer's definition I learned in my freshman year from the late Alexander C. Humphreys (then president of Stevens Institute of Technology) that, "Good Enough Is Best," I venture to offer a simpler solution of the interesting cocoanut problem than that given in Prof. N. G. Neare's column in the September issue.

I do not enjoy the luxury of a knowledge of congruences, or even of as much algebra as I secretly suspect might be required before one would think of Mr. Rowe's elegant solution. Therefore, I was forced to proceed with the only tool available to solve most practical problems, that is, the perception of simple relationships—sometimes called "common sense."

Rearranging Eq. 1 which, as Mr. Rowe stated, may be obtained from a simple algebraic statement of the problem, we have

$$5{,}000y + 1{,}441 = 81x \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (9)$$

Now it is evident that no matter what whole value we may assign to y the last three figures of the product $5{,}000y$ always will be ciphers. The sum of $5{,}000y$ and 1,441 as a consequence will always end in the number 441. In addition, we know that since any multiple of 5 must end in 5 or 0, the fourth figure from the right will be either a 6 or a 1.

We proceed next to find x, the original number of cocoanuts, by setting down the known part of the product, $81x$, as follows:

$$\begin{array}{r} 81 \\ \times ??? \\ \hline ???{}^{1}_{6}441 \end{array}$$

From this point on it is only simple arithmetic with the help of a "seeing eye" to note that the first figure of the unknown multiplier *must* be 1, and this gives 81 in the first line of the product as shown below. The figure in the second place of the multiplier *must* be 6.

Remembering to carry over one where necessary, the new figure needed is then that figure which, added to the previous results in the column considered, totals up to correspond with the known part of the answer below. This is more easily done than described. For example, it takes but a fraction of a second to note in the third column that 8 plus the carryover 1 is 9, and requires the addition of 5 in the third place of the multiplier to obtain a 4 when totaled. In like manner, the fourth place is found to require either a 1 or a 6, giving the first two answers, 1,561 and 6,561, of the infinite number of correct answers possible.

$$\begin{array}{r} 81 \\ {}^{1}_{6}561 \\ \hline 81 \\ 486 \\ 405 \\ 81 \\ 486 \\ \hline 126{,}441 \\ 531{,}441 \end{array} \quad \begin{array}{l} \\ \\ \\ \\ \\ \} \ . \ . \ . \ . \ (1) \\ \} \ . \ . \ . \ . \ (2) \\ \\ \} \ . \ . \ . \ (1) \\ \} \ . \ . \ . \ (2) \end{array}$$

Finishing the solution to obtain the successive differences in the product $81x$ which will be exactly divisible by 5,000 as required by the term $5{,}000y$, the final step is to note that any additional figures placed to the left of the 441 in the multiplier *must* be 1 plus any multiple of 5. We thus arrive at the same result expressed by Mr. Rowe's Eq. 8, namely, that any multiple of 5,000 added to 1,561 is a correct theoretical solution of the problem, barring such academic factors as the number of cocoanuts a dictator can manhandle in one night. Q.E.D.

Yonkers, N.Y. ALFRED AFRICANO, Assoc. M. Am. Soc. C.E.

Surface Preparation of Structural Steel for Painting

TO THE EDITOR: An interesting point presented in the symposium on "Preparing Structural Steel Surfaces for Painting," in the July issue, is that in the short space of a little more than a year the new process of flame cleaning and flame dehydrating has become a routine practice.

The several phases of this process should be understood and properly indexed. The term "flame descaling" should not be employed, as it is concerned entirely with the complete removal of scale as in the case of billets, slabs, and ingots. This is not necessary on structural steel and plate for which the proper terminology is "flame cleaning and dehydrating."

Loose and semi-adherent mill scale is cracked off as a result of the differential expansion between the scale and the base metal as well as the conversion to steam of moisture present, between the layers of scale and between the scale and steel. As the surface is rapidly heated to above 212 F, it is fully dehydrated and left in a warmed state conducive to adherence of the paint. Loosened scale and disintegrated rust are immediately removed by wire brush, and primer painting follows while the steel is still warm (above 100 F) and before recondensation has taken place. An inactive and protected surface is provided.

Unprotected steel reverts to its original iron oxide form. The presence of moisture and oxygen results in hydrated iron oxide, which is rust. This action is accelerated by other exposure conditions, and rusting is intensified by impurities in the metal. It is generally agreed that to secure an inactive, inhibited surface proper conditioning must take place immediately prior to primer painting. Dirt, rust, oil, grease, loose scale, and other impurities are focal points for progressive corrosion. If passivity can be retained, tight adherent scale is beneficial to the surface.

It is seen that dehydration is being accomplished by the application of heat supplied by the oxy-acetylene flame. The essentials of such application are: (1) The highest temperature flame available so that an instantaneous conduction of heat is provided through the scale-layers and to the steel surface; (2) a comparatively dry flame from which moisture, a product of combustion, is not deposited and retained on the surface of the steel; (3) a clean flame from which there is no smudge deposited; (4) a flexible flame which, by means of apparatus, may be extended over a given area and contour; and (5) a speedy flame of sufficient intensity to allow for fast action and securing the maximum area coverage in a given time.

Loose paint, mill scale, and rust on painted surfaces provide a condition allowing for the retention and concentration of corrosive matter. Before repainting these should be completely removed down to the clean steel, and moisture should be driven from the surface before recondensation occurs. Otherwise if the steel is exposed for any length of time to moisture and oxygen, oxidation begins. The oxide of iron in the remaining mill scale is replaced by an equal amount, in weight, of the corresponding hydroxides of iron, the constituents of rust. Such action is progressive and accumulative, and eventually results in the formation of heavy rust layers.

While it is shown that the oxy-acetylene flame does not completely remove rust, it most certainly dehydrates the rust and therefore removes the bonding agent—moisture. The structure is broken down and the accumulation is removed by wire brush. Heavy outer rust scale is displaced with scrapers before the flame application. Where the rust layers are extremely heavy and the expense does not warrant the use of the oxy-acetylene flame for their complete removal, they may be removed by chipping and scraping or sandblasting, supplemented by the oxy-acetylene flame for final surface conditioning and dehydration.

It is apparent that for either total or spot repainting this new oxy-acetylene process serves the major purpose. It is evident that dehydration can be accomplished on steel structures only by heat application, and it is also apparent that the oxy-acetylene flame offers the most efficient, economical, and fastest method for obtaining dehydration.

J. G. MAGRATH

New York, N.Y.

Closure of Discussion on Licensing Engineers

TO THE EDITOR: Mr. Legaré's article on legal registration, in the May issue, leads me to comment on the license racket of various states versus the young man. By way of preface I wish to state that I am a licensed consulting engineer and licensed architect. Forty years of observation have convinced me that licensing in any form is a viciously undemocratic way of handling a situation that is always presented to the public as a measure of protection to the public. It is the other way around! Licensing stifles competition and is a shameful way of framing the consumer.

If a man is capable of doing a good job, the public will find it out; if not, ditto. The public assumes that because a man has a bit of engraved paper with a seal on it he is competent, but some of the greatest incompetents in all professions are licensed, and they are the most vociferous about protecting the public.

As an example of this, if I may be pardoned for being personal, I was once called to another state, to redesign a building because

the contractor feared to build it without competent advice. At that time the state licensing code was put into effect and, being able to meet all requirements, I applied for a license. I was defeated by a member of the examining board because he was the architect whose plans I was called in to revise. (These facts I learned later on good authority.)

I will give a second illustration. I have associated with me at times on certain work one of the most thoroughly competent designers of small houses in this district. He is unable to get a state license as architect because he does not have the education (?). Yet this young man is taking contracts for and building the houses he designs to the delight of his customers. He is acquiring a sound reputation, but can't put his name on a single drawing he makes.

I am associated daily with men who can't get licenses, but are actually doing their various lines of work very competently because they are responsible employees of large corporations who assume the legal responsibility. Such men are barred from doing their special type of work privately, but big corporations are willing to pay high prices for their skill in the form of salaries.

I am forced to be a licensed engineer to protect myself from the competition of shysters in the profession. From the earliest days of my career, I have always considered membership in the American Society of Civil Engineers as the highest rating an engineer could have, and earned my way to that goal. But such membership is no guarantee that I can do an occasional job in my home state, nor does it prevent any aspiring young engineer from becoming tops in his chosen line of work. I am vitally opposed to the Society's supporting any licensing of any kind, except where forced to do so for the protection of its members, from those who would make a racket of the profession because they have a license. The whole idea is a racket to protect a few—wholly undemocratic and un-American. Long live the American Society of Civil Engineers!

CARL H. FULLER, Life Member, Am. Soc. C.E.
Youngstown, Ohio

TO THE EDITOR: The letter by Mr. Jacob Mark, in the September issue, styled by the editors under the accusing title of "Present License Laws a Hindrance to the Young Engineer," refers to my article on "Legal Registration of Professional Engineers," and I am therefore offering the following comments.

Mr. Mark states that "The laws of our state (presumably New York) have been used as patterns for about forty other states." I do not know of a single state registration law for engineers that was patterned after the New York law. Eleven states adopted registration laws before New York, and about half the present laws are based on the approved Model Law. Before discussing "the viciousness of these laws" it would be well to study more carefully "the underlying principles governing registration" as now observed in most of the forty-two states having registration laws.

Before engineering registration was developed there were no "barriers" or "restrictive laws" to prevent incompetent or dishonest men from practicing engineering or from pretending to be engineers. The "young engineer," therefore, had to compete with those who had no engineering education or training. After spending many years in intensive study and hard work, he was faced with the fact that his profession had done nothing to protect him in his efforts to become an engineer, as the profession was not then legally recognized by the public and the state. We who are "in" are determined not to "leave young men alone," but to continue our efforts to build up a profession of which they may be proud and one which will not permit such mockeries as "exterminator engineer," "hot dog engineer," etc.

I thoroughly agree with the last two sentences of Mr. Mark's letter in which he concludes that "Registration laws are in principle sound, . . ." From this his preceding remarks would seem to be misleading to the "young engineer." The Society and others deserve support in their efforts to correct any undesirable conditions that may exist, and in their desire to promote the benefits of engineering registration in the interest of the public, "the older men" and the "young engineer" alike.

In this issue Carl H. Fuller writes on the same subject. As his dissatisfaction is mostly with the registration of architects, it therefore concerns their procedure more than the registration of engineers. His reference to registration as "the license racket" in my opinion represents such a warped idea of a movement headed and supported by distinguished members of the American Society of Civil Engineers and other national engineering societies, that it tends to belittle his own viewpoint.

T. KEITH LEGARÉ, M. Am. Soc. C.E.
Member, Committee on Registration of Engineers; Executive Secretary, National Council of State Boards of Engineering Examiners
Columbia, S.C.

Types of Earth Dams

TO THE EDITOR: In connection with Mr. Hough's paper on "Types of Earth Dams," in the current issue, it is noted that the author quickly dismisses classes of earth dams other than rolled fill and thus narrows his subject to "types of rolled earth-fill dams." It is agreed that this is a logical choice, as the great majority of earth dams being constructed now and having been completed in the last decade are rolled embankments. Three conventional types are described and illustrated, namely, the "homogeneous," the "standard," and the "storage."

While nomenclature is relatively unimportant compared with the technical phases of the design of dams, yet it does have a valuable place in engineering literature. The term "homogeneous" is clearly expressive of the design, and to carry out the descriptive idea further it might have been more appropriate to refer to the "standard" as the "symmetrically zoned" and the "storage" as the "simply zoned." Particularly might there be some objection to the term "storage," as irrigation storage implies a fluctuating water surface and frequently a rapid draw-down, appurtenant to which the author correctly states this type of dam is not suitable.

With respect to "when to design a dam," there can be no disagreement with the author's favored policy of exploring and classifying the materials close to the given site before making the first outlines of a final design, although the word "final" might well be preceded by "semi" or proposed. Ordinarily there is no final design on a zoned earth-fill dam until construction is completed.

One of the outstanding features of the "interior drainage" type is the inclined core section of the impervious zone, which, together with a small transition or filter zone, overhangs a large part of the select pervious or free-draining zone as well as a part of the random zone. If it is proposed that this random zone would be uncompacted, as in a similar zone in the Whitney Point Dam, the relatively large progressive settlement and the results of such settlement on the upstream overhanging zones should be given careful study. Moreover, it is possible, under the usual present-day specifications for compacting the various zones in earth dams, that the rate of settlement of a pervious zone may be greater than for an impervious zone. It is not inconceivable that such unequal settlement, should it develop, in the "interior drainage" type as proposed, might eventually result in some cracking of the narrow impervious core, possibly permitting a much too rapid flow of water. In any event, it is not believed that the problem of unequal settlement between the different triangular or trapezoidal zones in the conventional types of earth dams listed by Mr. Hough is of any consequence; but it is suggested that in the proposed "interior drainage" type, as outlined in Fig. 4 of his paper, unequal settlement should be given consideration. Such consideration might result in some modifications of the zone slopes, or greater attention to the compacting of the downstream zones.

While the "interior drainage" type in a model test possessed a high degree of stability against wave action, there is some question whether the crest of the impervious zone in a prototype could be expected to permanently withstand this wash through the select pervious section. Should there be a progressive erosion of this kind, the drainage zones might become filled with fine materials from the impervious zone to such an extent that they would not function as drains. In this event, the advantages gained in damping wave action would be greatly diminished.

K. B. KEENER, M. Am. Soc. C.E.
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Denver, Colo.

Pipe and Right of Way for the Wichita Water Supply

TO THE EDITOR: In his article on "A New Water Supply for Wichita, Kans.," in the September issue, Mr. Lawrence has mentioned the cast-iron pipe line as following the "new law of design." This pipe line is perhaps the outstanding feature of the water supply plant. It includes approximately 93,000 ft of 48-in., 27,000 ft of 42-in., 8,000 ft of 36-in., 7,000 ft of 30-in., 8,000 ft of 24-in., 5,000 ft of 20-in., and 25,000 ft of 14-in. pipe. The line is designed for a gravity discharge of 30 mgd. The grade is about 5 ft per mile, with the ground so flat that it is little more than 10 ft below hydraulic gradient at any point. The pipe line was designed for low pressure without a field reservoir.

The engineers prepared plans and specifications for cast-iron, steel, and reinforced concrete pipe, recommending to the city that a base bid be considered on cast iron. After considerable discussion, the city commission disapproved the recommendation and advertised for bids on an equal competitive price basis. In the meantime, the interested railroads announced an agreed reduction in freight on cast pipe from the Birmingham district amounting to about $75,000, followed by comparable reductions in freight on steel pipe. In order to take advantage of the reduced freight, the city had to buy and own the pipe at point of manufacture. This in turn required the letting of separate contracts for furnishing the pipe, for handling it from the nearest rail delivery points, and for laying it. In addition to that, the city commission desired separate bids on pipe over and under 36 in., and, of course, on laying the two sections.

Bids on two lengths of cast pipe in the larger sizes and three in the smaller, three lengths of steel pipe, and one length of concrete pipe, combined with the bids of ten pipe-laying contractors, produced a possibility of literally hundreds of combinations. Fortunately it was not too difficult to determine the two lowest bidders.

The consulting engineers were not required to furnish right of way. All the permanent wells are located 20 to 30 miles from Wichita in another county. The time necessarily consumed in completing the preliminary drilling for locations left very little time for purchasing permanent well sites. The city employed a professional "lease hound," and gave him a list of approximate locations and a limit on price. Later the limit had to be raised slightly, but in a month he had obtained options on 26 sites of 5 acres each with blanket pipe line right-of-way options on most of the farms in the well field. Many details, such as tenant's crop loss on well sites, crop damage from well discharge during the test pumping, highway damage from inadequate drainage, and exact location of pipe lines, were necessarily incomplete.

Another representative of the city was able to satisfy all claims for crop and special damage at a reasonable rate and to acquire right of way on the remainder of the pipe line by deliberate negotiation without the necessity for condemnation except in one instance. The price paid was the same in all cases and appeared high until the report of appraisers was filed in the county in which Wichita is located. There was sufficient time available for condemnation in this county and that method was used.

The price paid for each well site, including right to pump water from the farm, was $1,000. The negotiated permanent pipe line right of way cost $1 per sq rod, including construction crop damage. The base price paid on condemnation was $100 per acre for permanent right of way, but supplemental items substantially increased this amount.

P. L. BROCKWAY, M. Am. Soc. C.E.
City Engineer
Wichita, Kans.

Hydrology of the Wichita Area

TO THE EDITOR: Referring to Mr. Lawrence's article, "A New Water Supply for Wichita, Kans.," in the September issue, I should like to call attention to one of the stipulations in the specifications for testing and accepting the new wells. The acceptance of a completed well was based largely upon a certain minimum yield of sand-free water at a drawdown after 36 hours of pumping of not more than 30% of the total static-water depth. It is considered better practice to rate the capacity of a well by the yield in gallons a minute together with the drawdown in feet. The specific capacity of a well is then determined by dividing the yield by the drawdown to give the number of gallons a minute per foot of drawdown.

To illustrate, let us assume two wells having identical yields and drawdowns, say 1,000 gpm with a drawdown of 20 ft, but assume that one well is much deeper and has a static-water depth twice as great as the other. Both wells will then have the same specific capacity—50 gpm per foot of drawdown—but the deeper well will have only half the drawdown in percentage of total static-water depth as the shallow well. Obviously, therefore, the drawdown in percentage of total static-water depth has no real significance, and, other things being equal, it varies merely with the depth of the well.

The contour map of the area, prepared by the U.S. Geological Survey and described in part by Mr. Lawrence, also shows that the water table forms a ridge beneath the sand hills, thus reflecting the favorable recharge conditions afforded by the loose sand. Drillers and others have long supposed that there is movement of ground water from the Smoky Hill River southward toward the Arkansas Valley. As shown by the contour map, however, there is a ground-water divide south of McPherson, hence no water can flow southward from the Smoky Hill Valley. On the contrary, north of the divide the movement is toward the Smoky Hill Valley.

A new contour map is being prepared to show the exact level and shape of the water table just prior to the time the well field was put into operation. In 1941 it is planned to measure these wells again for the construction of a third contour map. By superimposing the two water-table contour maps, the volume of sediments unwatered within the cone of depression during the year may be computed. By making certain assumptions as to the specific yield of the materials, it will then be possible to arrive at the total quantity of water withdrawn from storage during the year. By subtracting this quantity of water from the total quantity of water pumped during the year, the amount of water contributed by rainfall may be computed. It is intended similarly to inventory the ground-water reservoir at the end of succeeding years. This will constitute a method of determining the safe yield of the well field—that is, the quantity of water that may be withdrawn perennially without impairing the adequacy of the supply. If, at any time, the results should indicate that the safe yield is being equalled or exceeded, steps should be taken to extend the well field, and consideration should be given to the possibility of artificial recharge from the Little Arkansas River.

S. W. LOHMAN
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Lawrence, Kans.

Plane-Table Surveying

DEAR SIR: The article by L. B. Roberts on reconnaissance surveying, in the September issue, discusses a method of plane-table surveying that is very familiar to me and brings back memories of long hard days in mosquito and fly-infested swamps in northern Maine. He refers to the linen tape, aneroid, compass survey which was quite aptly named by U.S. Geological Survey topographers several years ago as the "Hoot an' Holler Traverse." Several modifications of this method can be used, and each has certain advantages. It is sometimes faster to use a 550-ft tape than a 320-ft tape, as Mr. Roberts suggests. The extra length to be used to account for winding depends on the steepness of the country, the thickness of the underbrush, the rodman, and how well paraffined the tape is kept.

Experience will teach the surveyor how to account for various degrees of winding by watching the course of the tape as he proceeds to the rodman's station. If the rodman is experienced, faster time can be made by both men moving at the same time. After the rodman has shouted and the direction of his voice has been plotted, and the necessary sketching has been done, the instrumentman can take a few steps forward and then shout for the rodman to proceed. The rodman will mark his station by blazing a tree, breaking a bush, or by any other convenient method, and then will pass the tape around the bush or tree, thus putting a kink in the line in order to keep the instrumentman from missing the point. This method requires more set-ups and orientations, but at the same time allows more frequent intervals to sketch from.

Usually the topographer travels faster than the rodman, in which case he will have the plane table oriented before the end of the tape arrives at his station. This process can be reversed if the course has not been pretty well predetermined, or if the rodman is inexperienced or lacks aptitude for following the features desired.

As Mr. Roberts states, fair accuracy can be obtained by this method if accurate stadia traverses have cut the area into sections small enough for ties within a limit up to about three miles. Experienced "tapers" will close one-mile traverses under 300 ft of correct horizontal position and three-mile traverses under very little more than this when using a scale of 1:48,000. The same care must be taken in this type of surveying as when more precise instruments are used. I once knew of a topographer who left his tape stretched out in front of his camp over night and then taped for three days before he discovered that a porcupine had chewed the tape in two, 75 ft from the rear end. A very poor run of closures worried me considerably, one time, until I found out that my right ear was partially clogged with wax causing me to travel in a wide arc to the left.

An aneroid is the topographer's best friend, but it takes time for the friendship to mature. From 7 to about 11 a.m. an aneroid ordinarily works very nicely if the weather is clear. An aneroid with 20-ft divisions will usually be within 10 ft of correct during this part of the day. From 11 a.m. to 2 p.m. they apparently feel the need of a siesta and will soar to elevations as much as 200 ft too high. I once had one "jump" 100 ft in 15 minutes while I was standing still in a swamp waiting for a thunder shower to pass over.

The "Hoot an' Holler" method is easily and quickly taught to inexperienced men and thereby offers an opportunity for rapid and inexpensive reconnaissance mapping. An experienced party will traverse from 3 to 7 miles per day in medium rough country when mapping on a scale of 1:48,000 with 20-ft or greater contour intervals.

ROGER E. AMIDON, Assoc. M. Am. Soc. C.E.
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Engineering Specifications Should Be Discussed

TO THE EDITOR: In the article, "Freedom to 'Talk Back,'" in the September issue, Dean Agg ascribes importance to the free discussion of the papers presented in PROCEEDINGS. He considers the discussion of papers a duty as well as a privilege.

Discussion of papers is, no doubt, beneficial, but valuable or useless, discussed or not, the material presented in papers does not necessarily affect the work of designing engineers. It is not compulsory to adhere to any of the recommendations or to take notice of the truth of the statements in the publications. Study of the presented material may lead to progress in design, although progress is often hampered by the rigid rules of the authoritative design specifications. These specifications come into being without the benefit of wide general discussion, and their provisions become the law of the land without the possibility of being altered by the dissenting opinion of engineers who are not on the formulating committees.

Design specifications affect the quality and type of structures. Absence of provisions for certain types excludes the use of those types in the average design office. The authoritative specifications are the most efficient means for the promotion of advance in design. They have to be studied and conformed to.

The essential features of specifications are the loads to be designed for and a collection of rules defining the factor of safety. Requirements of simplicity and practicability limit the number of rules, but since these must cover a wide field of conditions, their correctness depends in varying degree on their range of application. The simplicity of the generalized design rules depends on the complexity of the functional relations which these rules are intended to approximate. The correctness of the approximations and the easy applicability of such provisions depend on the knowledge and skill of the rule makers.

It took half a century to bring design specifications into some agreement with existing knowledge of the behavior of continuous and rigid-frame structures. The structural behavior of slabs was understood for over two decades before faulty design provisions were revised. At present there are no provisions for the design of elastically braced compression chords, and no similarly essential paragraphs to promote general advance in bridge design. Steel bridge specifications still recommend pin-connected structures. Other cases of faultiness in existing provisions and the entire lack of certain other important ones could be pointed out.

The role of specifications in structural design demands that engineers shall have an opportunity to discuss them before their final printing. Discussions that appear after the final printing are useless because they cannot receive consideration.

The draft of the proposed authoritative specifications should be published with an invitation for comment and discussion at least three months before proposed final publication. The adoption of such a practice would inevitably result in progress; it befits a learned profession and is in the spirit of Dean Agg's valued free right to "talk back."

LOUIS BALOG
Engineer, Leon S. Moisseiff, Consulting Engineer
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The Engineer's Role in Society

DEAR SIR: I was interested in Professor Burdell's article in the August issue. Much has been made lately over the discovery that, in social, economic, and political spheres, the engineer is playing a part disproportionate to his background, training, intelligence, and integrity.

Naturally engineers, who are held together on fundamental principles, as scientific truths, are wary of changing views with each popular swing of the pendulum. Nevertheless, it is surprising that such men, whose very livelihoods depend on progress, pioneering, and foresight, are so slow to act constructively when confronted with problems that strike directly at the well-being of the individual.

We engineers, assuming a superior knowledge for man's welfare, cannot thrust the fuller world on people. So it was with Galileo; so it is with us. The immediate gain, the reward of the moment, are uppermost in the minds of the masses.

But, before any solutions are offered, let us see what our aims are and what we hope to achieve. Ideally, we want to reap a just and equitable recompense and respect. We want to express ourselves in a way more in keeping with our knowledge and profession. We want to achieve a more progressively civilized life for mankind. Practically, we want more money; we want a better social standing; we want more influence.

Hundreds of young engineers who have graduated in the past twelve or fifteen years and have been for years without a permanent position have seen the breakdown of our daily system of life. Analyzing this tragedy, we find it is because they have not been able to hold their own in the social field, have not been able to bargain fairly for themselves, have not been able to state their opinion in political crises. Perhaps, they were too good, too prudish, too consciously ethical. More experienced engineers have applied the engineering mode of thought to solve the problem, when they should have used their knowledge, their experience, and their common sense.

Our ethics will stand. Our integrity is good. Our motives will take care of themselves. No one is to blame if we have a problem. The important thing is that we get right down to wrestle with and to solve it.

In our dealings with others let us quit being bluffed; in our bargaining let us pick up the tempo of the argument. We should avoid standing around like wooden Indians in social converse and say something right or wrong. We are not here confronted with an engineering problem of construction that needs checking and double checking, but of momentarily changing motives, ideas, and interest.

We do not necessarily have to change our academic curricula to allow more English and literature. What we need is a more expansive attitude, a fresher atmosphere of good fellowship, and a hearty laugh at our engineering seriousness of purpose. The details will adjust. Let our leaders show the way. We engineers of the hard times are eager to follow.

I. GEORGE BRADLEY
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Overflow Spillway Sections

TO THE EDITOR: The article by A. S. Offitzeroff on "Model Studies of Overflow Spillway Sections," in the August issue, treats of a subject that has needed further investigation for many years. Heretofore, hydraulic engineers have usually patterned the spillway crest after the nappe profile of the vertical sharp-crest weir, paying little or no attention to the effect of varying the angle of the plane portion of both the upstream and downstream face of the spillway section.

In his experiments, the author made the plane portions of the spillway sections for several face angles tangent to the nappe profile of a vertical sharp-crest weir of negligible velocity of approach. In cases where the upstream side of the weir is inclined up or down stream, such inclination modifies not only the form of the nappe, but also the discharge coefficient, the latter being intimately related to the contraction that takes place at the crest of the weir. The following table shows the departure of the author's experimental crest profile for the upstream face angle equal to 15° from Bazin's nappe profile for a sharp-crest weir sloping 1:4 (14° 2′) downstream.

COORDINATES OF SPILLWAY SECTION FOR UNIT HEAD ON CREST
$\alpha_1 = 15°$

x	y (author's profile)	y (Bazin's nappe profile)
0	0.019	0.003
0.05	0.007	0
0.10	0.002	0.005
0.15	0	0.013
0.25	0.006	0.036
0.40	0.043	0.090
0.60	0.121	0.188
0.80	0.227	0.321
1.00	0.358	0.477
1.20	0.518	0.666
1.40	0.710	0.888
1.60	0.928	1.136
1.80	1.169	1.408
2.00	1.440	1.721

The table indicates that the author's spillway profile is too conservative, extending well beyond the nappe profile. A spillway section designed after Bazin's nappe profile would effect a worthwhile saving in the size of section and result in a higher discharge coefficient, due to the greater sharpness of crest.

By comparing the value of m reported by Bazin for his inclined 1:4 downstream sharp-crest weir with that of the author's "standard" spillway, m_α is computed to be 0.948 instead of 0.928 as shown in the author's Fig. 4. The corresponding comparison for the coefficient, C, in the formula $Q = CLH^3/_2$, used by American engineers, yields a value of 3.80 instead of 3.72. Indeed, the difference is small but significant when dealing with high discharges.

Experiments have shown that the nappe is not affected by the presence of a fixed lower boundary, so long as the spillway curve conforms exactly to that of the free nappe for the design head. Hence, it would be expected that a spillway section with 1:4 upstream face and the curved portion designed to fit the nappe of the inclined sharp-crest weir would perform exactly as the sharp-crest weir and would show the same discrepancy when compared with the author's spillway section. Therefore, the values of m_α, shown in Fig. 4, would be somewhat higher for spillway sections designed to fit the nappe profiles corresponding to the upstream face angles.

With regard to the effect of submergence on the discharge of weirs, some investigators have found that the influence upon the rate of discharge begins somewhat before the tailwater reaches the level of the crest, owing to the fact that the pressure intensity within the nappe does not approach zero until well past the weir crest. The reduction in discharge apparently is small as the author's measurements, presented graphically in his Fig. 5, show no reduction for the tailwater below the crest level. This reduction is known to be of significance, however, when the invert of the downstream channel approaches the crest level. The deflection of the nappe by the lower boundary affects an increase in pressure intensity at the weir crest, resulting in the reduction in discharge.

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Need for Accurate Data on Classification of Engineers

TO THE EDITOR: The thesis presented in the article appearing in the September number of CIVIL ENGINEERING, entitled "Are Enough Students Being Trained in Civil Engineering?" by Messrs. Tyler and Hennes, is to the effect that the demand for civil engineers in this country is not being met by the number of civil engineering students being graduated from engineering schools. The demand is represented by census figures of those gainfully employed in the four census classifications of (1) Civil Engineers and Surveyors, (2) Electrical Engineers, (3) Mechanical Engineers and other Engineers, and (4) Mining, Metallurgical, and Chemical Engineers, while the supply is represented by the number graduating from the various courses offered in engineering schools.

The writer, following an investigation made a few years ago, came to the definite conclusion that no statistical studies, which were based upon census figures of persons gainfully employed as technical engineers, could be relied upon to give dependable results. The writer further concluded that no correlation existed between the number of technical engineers listed in the census, either as a whole or in the four classifications, and such other variables as membership in engineering societies, number of registered engineers, or value of manufactured products, value of construction work, total wealth, total population, and similar items.

The membership rolls of engineering societies are no measure of the number of engineers in an area. In some places society members are very active in bringing into the society all eligible engineers, while in others the societies are poorly supported. A sample check of the rosters of the A. I. M. E. and the Am. Soc. C.E., made by the writer a few years ago, supports this contention, and indicates that but from one-third to one-half the membership of these societies is engaged in the branch of engineering represented by the society.

The number of registered engineers is an equally fallacious measure. Some state boards have the hearty support of organized engineers and the public, and register a high percentage of those legally required to register, enforcing the registration law aggressively, while other boards do not have such public or professional support and conduct a feeble policy of enforcement, with the result that but a small proportion of those who should be legally registered are.

The 1930 federal census lists the following number of persons gainfully employed as technical engineers:

	TOTAL	PERCENTAGE OF TOTAL
Civil Engineers and Surveyors	102,086	45.2
Electrical Engineers	57,776	25.5
Mechanical Engineers and others	54,417	24.0
Mining Engineers and Metallurgists	11,960	5.3

However, there are also many other classifications—such as draftsmen, designers, builders and building contractors, public service officials, and college presidents and professors, to mention a few—which doubtless include many who would be considered as professional engineers.

The writer discussed this situation at the time with Mr. Virgil Reed, Acting Director of the Census, and came to the conclusion that little could be done to remedy it. The census enumerator must take the statement of the person contacted as to the occupation of himself and those in his household. For instance, the wife of one city engineer may list him as a civil engineer, while the wife of another may list him as a public official.

While use of data within a certain class may afford indications of trends, the writer does not believe that any correlation exists between data of different classes. He further believes that because of the quality of census data regarding the number of technical engineers, conclusions drawn from such data are apt to be erroneous.

Research of the type presented by Messrs. Tyler and Hennes is sadly needed, but before much can be done the quality of basic data available must be greatly improved. Perhaps some method of sampling, along the lines followed in the Gallup and Fortune polls, would give more accurate figures as to the number, classification, and distribution of engineers than is afforded by census figures. This is not meant to be derogatory of the quality of census data in general, for it so happens that the question as to when a person is gainfully occupied as a technical engineer has not yet been settled by engineers themselves, so the Census Bureau cannot be blamed for the existence of this condition.

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Consulting Engineer

SOCIETY AFFAIRS

Official and Semi-Official

Cincinnati Meeting in Review

Civil Engineers Gather in the Ohio Valley for a Notable Program of Events, October 16–18

CLEAR AUTUMN SKIES, ample meeting accommodations, and hospitable greetings from local members constituted a warm welcome to a large number of engineers and their guests as they assembled for the Fall Meeting in Cincinnati. Representatives from various localities, but of course predominantly from the Ohio Valley, congregated at the Netherland Plaza Hotel, where on Wednesday, October 16, the meeting started. For three full days, the "Queen City" lived up to its fine reputation for entertaining visiting groups such as the Society.

With respect to the technical meetings, the program was divided into two main parts—general and Division sessions. Although the programs of the Divisions were compressed into two half days on Thursday, October 17, the general meeting was spread over three half days—Wednesday morning and afternoon, and Friday morning. Social events of course were scattered throughout the period of the Meeting.

All the papers presented at the general meeting were concerned with the relation of the engineer to municipal problems. This program started on Wednesday morning, October 16, immediately following the customary courtesies of official opening, civic welcome, and response by the President of the Society. Papers presented at the morning and afternoon sessions dealt with the civic responsibilities of the engineer in general and, in particular, his interest in the fields of city planning, municipal sanitation, and transportation. At the session on Friday morning, renewed consideration was given to this large problem in papers dealing with the engineer's esthetic responsibilities and his viewpoint on municipal organization. Opportunity was given in all cases for discussion, participated in by experts who responded by invitation as well as by extemporaneous comment from the floor.

These sessions were so arranged as not to conflict with other events, thus encouraging full attendance. Following the same plan, Thursday was devoted to the Technical Division sessions, held simultaneously. An all-day program was arranged by the Power Division; the morning papers dealt with hydraulic turbine practice, cavitation, and ventilation of stations, while the papers in the afternoon were concerned with space for power houses and with waterways and gates for hydroelectric developments.

A single joint session in the morning was arranged by the City Planning and Surveying and Mapping Divisions. Their program comprised two papers, the first dealing with examples of financial savings resulting from the master city plan for Cincinnati, and the second with the relationship of topographic mapping to city planning. The outstanding experience of this large metropolis gave these papers a special interest, and the subject fitted in well with the papers presented at the general meeting, which were along similar lines. Many of the conclusions of the authors were supplemented by the comments of discussers who had first-hand knowledge of local conditions.

In the afternoon the Sanitary and Highway Divisions held separate sessions, in both of which nearby projects had the center of the stage. Sanitary engineers listened to three papers covering Toledo's water supply from Lake Erie; municipal water supply, sewage treatment, and stream pollution control in Ohio; and biochemical sewage treatment at Anderson, Ind. Three papers also were presented before the highway engineers—on main routes through municipalities, on the state highway planning survey, and on highway research—by representatives of state highway departments in Ohio, Kentucky, and Indiana.

The schedule called for completion of the Division sessions in the middle of the afternoon so as to allow time for a special bus tour of the city and its interesting developments, some of which had been the subject of technical papers. In the evening there was an enjoyable dinner and entertainment at the headquarters hotel, with the added feature of an address on the geological background of the city and surrounding area.

Wednesday evening was the high point in the social events. A large number of members and guests, with their ladies, sat down to an excellent dinner at the headquarters hotel. At its conclusion, there was an address on "The Function of the City," which received enthusiastic attention. To conclude the program dancing was enjoyed by all. This gala social event of the meeting was characterized by the attendance of a brilliant company of engineers and their guests, by an exhibition of professional ballroom dancing, and by a dinner of high quality.

As usual at Society meetings, special features were provided to entertain the ladies while the men were attending the technical sessions. Wednesday noon the first event of this sort took place—a luncheon at the headquarters hotel followed by special tours through museums and other local centers of interest. The following noon there was another luncheon—a special one at the Hamilton Country Club just outside the city limits. Afterwards there were cards for those who desired to play, and others were at liberty to spend their time in conversation or in walks about the beautiful grounds of the club.

Coincident with the meeting, opportunity was taken to arrange for a number of coordinate activities. Largest of these was the Student Chapter Conference on Wednesday and Thursday, held under the auspices of the Society's Committee on Student Chapters. On Wednesday afternoon, when the first session was held, there were talks by older members who had made a close study of student activities, followed by general discussion. Then many of the groups repaired to the Student Union of the University of Cincinnati, where the dinner, accompanied by an inspiring address on the student's relation to preparedness, was served. It was followed by an informal dance. The Thursday morning session was devoted to the meeting of the North Central Student Conference, with reports, elections, and other official business. Also on the program was a most interesting presentation of

Frederick Hall Fowler Is Official Nominee for President for 1941

The nominating committee of the Society met in Cincinnati, Ohio, on October 14 and unanimously named Frederick Hall Fowler, M. Am. Soc. C.E., as its choice for official nominee for President of the Society during 1941. Mr. Fowler has accepted the nomination.

Most of his career has centered in the West, following graduation from Stanford University in 1905. In particular, problems of dams, water, and power have engaged his attention. Since 1922 he has maintained consulting offices in San Francisco. In recent years he has done extensive work for the government, in connection with projects of the Public Works Administration.

He has served the Society as Director and the San Francisco Section as President. A friendly personality and a gracious presence on the platform, combined with a notable engineering practice, have made him one of the leading figures in the profession. A more extensive account of his career will be published later.

LOCAL SECTIONS CONFERENCE IN CINCINNATI, OHIO, OCTOBER 15, 1940, AT HOTEL NETHERLAND PLAZA

Front Row, Left to Right: *E. R. Cary, Past-President, South Carolina Section; W. C. Taylor, Past-President, Mohawk-Hudson Section; J. E. Jagger, Secretary-Treasurer, Alabama Section; J. T. McNew, Local Sections Committee, Texas; W. M. Spann, Local Sections Committee, Kansas City; James W. Follin, Chairman, Local Sections Committee, New York; Hal H. Hale, Local Sections Committee, Atlanta; C. P. Hazelet, Secretary, Illinois Section; Herman Stabler, District of Columbia Section; Benjamin E. Jones, Secretary, District of Columbia Section.*

Second Row, Left to Right: *Fred F. McMinn, Vice-President, Cincinnati Section; Walter E. Jessup, Field Secretary, Am. Soc. C.E.; Robert B. Jennings, President, Central Ohio Section; Clinton Morse, Secretary-Treasurer, Panama Section; E. M. Killough, Vice-President, Maryland Section; Denzil Doggett, Secretary, Indiana Section; John F. Reynolds, President, Florida Section; W. A. D. Wurts, President, Connecticut Section; A. S. Fry, President, Tennessee Valley Section; W. A. Coolidge, Past-President, Nashville Section; Norman H. Davidson, President, Rochester Section; R. A. Nyquist, Vice-President, Toledo Section.*

Back Row, Left to Right: *Francis H. Kingsbury, Secretary-Treasurer, Northeastern Section; Louis P. Blum, President, Pittsburgh Section; P. A. Rice, Secretary-Treasurer, Virginia Section; Edwyn L. Shoemaker, Secretary-Treasurer, Philadelphia Section; G. Brooks Earnest, Secretary-Treasurer, Cleveland Section; Cecil S. Camp, Secretary-Treasurer, Syracuse Section; Frank Stubbs, Chairman, Providence Section; George E. Hubbell, Secretary-Treasurer, Michigan Section; Admiral R. E. Bakenhus, Past-President, Metropolitan Section; M. W. Tatlock, Vice-President, Dayton Section.*

student papers in competition for certificates of award. This morning session was at the University of Cincinnati, with the luncheon following, attended by well over a hundred. Students from many Chapters throughout the state, and from as far as South Carolina and Maryland, took advantage of the opportunity for a most worth-while exchange of ideas.

Another gathering held in conjunction with the Cincinnati Meeting was the regular Local Sections Conference, which met morning and afternoon on Tuesday. To it came representatives from many of the Sections, as illustrated by the accompanying group photograph. Professional rather than technical subjects occupied the conference. From it the members who attended took back to their home Sections many new ideas to aid them in making the most of the opportunities there.

Of special note among the social gatherings was one held on Monday evening before the meeting proper had begun. Local engineers took advantage of the early attendance of Board and committee members to arrange a delightful informal dinner at the spacious Cincinnati Club.

As time permitted before, after, and between meeting sessions, members were enabled to study with profit a large number of engineering exhibits that filled foyers and lobbies of the headquarters hotel. The city itself, through its various departments, contributed largely, with maps, photographs, and models. Equally of interest were a number of elaborate models furnished by the local U.S. Engineer Office. Other showings included drawings by students of the University of Cincinnati, about 40 educational exhibits by the State Highway Department and displays by organizations such as the Cincinnati Gas and Electric Company, the Portland Cement Association, and the Cincinnati Street Railway.

Following conclusion of the general technical session Friday forenoon, and an early lunch, buses were waiting to convey an inspection party to Middletown, Ohio, about 35 miles distant, to visit the large plant of the American Rolling Mills Company, pioneer in the manufacture of ingot iron, in the continuous strip process for steel sheet production, and in harmonious labor relations. Two buses and a number of private cars provided transportation. Rigid government restrictions had been relaxed to permit limited inspection of this key plant.

In turn the party visited the open hearth furnaces, the continuous rolling mill turning out "hot strip," then the cold reduction mills and intermediate processing. In another part of the huge plant the party witnessed the fabrication from the sheet metal of such products as helically corrugated pipe, tunnel liners, and spirally welded pipe. Then came display rooms, and finally a fully equipped testing laboratory. As dinner time had now arrived, the entire party was taken to a nearby hotel, where visitors, officials, and guides to the number of 125 were treated to a sumptuous turkey dinner as guests of the company. Brief greetings and responses followed the dinner, bringing to a close a most instructive and pleasurable afternoon and evening, thanks to the generous hospitality of Armco.

Total attendance at the meeting reached almost 600. All the appointments for conducting a successful gathering were carefully arranged. Both men's and women's committees worked hard and successfully, each contributing the necessary elements to assure enjoyment and profit by all. To these committees go the hearty thanks of the Society and of the members, ladies, and guests who enjoyed the hospitality of the Cincinnati engineers.

Part of the Day's Work

IT IS taken for granted, of course, that an organization like the Society is always ready to help its members. That it also fulfills a duty to the engineering profession outside the limitations of membership, is shown by the following incident, illustrative of one sort of detail that the staff is called upon to handle in the course of the day's work.

A while ago a young woman came into Society Headquarters. She had been crying and was in great distress because her brother, who was employed on an engineering project in upstate New York, had just been killed in an accident (but not on the job). He was apparently the sole support of his parents and several brothers and there was no money to take care of the necessary funeral arrangements. The young woman said that, although her brother was not a member of the Society, she thought she remembered seeing the name of the Society on mail sent to him—hence her appeal for help.

First, members of the staff got in touch with the Civil Service Commission and found that the brother was eligible for a few months' financial consideration. It was also found that he had belonged to the National Guard for ten years, and telephone conversations with the relief department of this organization secured a promise that the matter would be investigated. Later a letter was received from the young woman stating that, thanks to the Society, everything had been arranged satisfactorily and that the sum received from the Civil Service Commission would take care of the necessary expenses.

J. Waldo Smith Hydraulic Fellowship Awarded for 1940–1941

ON RECOMMENDATION of the Committee on the J. Waldo Smith Hydraulic Fellowship, the Board of Direction has awarded this fellowship for 1940–1941 to the University of Iowa, through its Hydraulic Laboratory, and to James Mueller Robertson, Jun. Am. Soc. C.E. Mr. Robertson is now at the University, where he also took his undergraduate work. His research, under the terms of the award, will concern itself with "determination of the extent to which entrained air is carried along by water in a circular pipe laid on a down grade."

One of the important factors in determining this award was the facilities available at the Iowa City laboratory. The problem is one in which the laboratory and its directing engineers are interested, and in which full cooperation with personnel and equipment is to be expected. This fortunate situation speaks well not only for the progressive policy of the University but for the possibilities of success of this investigation.

According to the regulations governing the fellowship, the sum of $1,000 is made available over the year; $600 of this is in the form of a stipend, and up to $400 is offered to cover the cost of materials and special equipment. Mr. Robertson and the University of Iowa Hydraulic Laboratory are to be congratulated. The Society's Committee on the J. Waldo Smith Hydraulic Fellowship consists of Charles M. Allen, Roger W. Armstrong, and Karl R. Kennison, chairman.

Manual on Control Surveys

SINCE 1927, when the Code of Practice was published as Manual of Engineering Practice No. 1, the Divisions of the Society have presented 19 such manuals to the membership. With the exception of 1930, when four manuals were published, the year 1940 has marked the most active period of manual production in the 13-year history of this important work.

Some time before Thanksgiving, it is the hope of the Committee on Publications that Manual No. 20, on control surveys, will be added to the growing list. This is an activity of the Surveying and Mapping Division dating from the very beginning of the Division itself in 1926. The committee was created for the purpose of acting as an agency to answer questions on the subject.

The manual covers horizontal control surveys to supplement the fundamental net, and is designed to be of service to the practicing surveyor. Much credit is due to the committee: E. A. Bayley, H. W. Hemple, O. de la V. Keese, R. H. Randall, J. G. Staack, R. L. Sumwalt, C. J. Tilden, with Philip Kissam as chairman.

As Manual No. 20 is distributed to all members, its sponsoring committee hopes it will well serve the profession at large, and in particular those in its special field.

Society Officers Nominated for 1941

THE Second Ballot to determine the official nominees to Society Offices other than president for 1941 was canvassed on October 15, 1940. The official nominee for President was chosen by the Nominating Committee on October 14, in accordance with Article VII, Section 4, of the Constitution. The complete list of nominees is:

For President:
- Frederick Hall Fowler, of San Francisco, Calif.

For Vice-Presidents:
- Zone II, Charles Henry Stevens, of Philadelphia, Pa.
- Zone III, Charles Baker Burdick, of Chicago, Ill.

For Directors:
- District 3, John Whitfield Cowper, of Buffalo, N.Y.
- District 5, Gustav Jaeger Requardt, of Baltimore, Md.
- District 7, William Nelson Carey, of St. Paul, Minn.
- District 8, George Bragg Massey, of Chicago, Ill.
- District 9, Ralph Benjamin Wiley, of West Lafayette, Ind.
- District 12, John Wilbur Cunningham, of Portland, Ore.
- District 16, Ernest Emmanuel Howard, of Kansas City, Mo.

These nominees will be voted on by the use of final ballots sent to every corporate member at least 40 days before the Annual Meeting in January. One week before the meeting the ballots will be canvassed, and the elected officers will be inducted into office at the meeting. The official report of the tellers follows:

REPORT OF TELLERS ON SECOND BALLOT FOR OFFICIAL NOMINEES

October 15, 1940

To the Secretary
American Society of Civil Engineers

The tellers appointed to canvass the Second Ballot for Official Nominees report as follows:

For Vice-President, Zone II		
Charles Henry Stevens	867	
Void	2	
Total	869	
For Vice-President, Zone III		
Charles Baker Burdick	1,148	
Void	3	
Total	1,151	
For Director, District 3		
John Whitfield Cowper	174	
Solomon Cady Hollister	144	
Void	2	
Total	320	
For Director, District 5		
Gustav Jaeger Requardt	295	
Void	0	
Total	295	
For Director, District 7		
William Nelson Carey	238	
Void	0	
Total	238	
For Director, District 8		
George Bragg Massey	246	
Void	1	
Total	247	
For Director, District 9		
Ralph Benjamin Wiley	164	
George Nelson Schoonmaker	145	
Void	2	
Total	311	
For Director, District 12		
John Wilbur Cunningham	120	
Claude Irving Grimm	97	
Void	1	
Total	218	
For Director, District 16		
Ernest Emmanuel Howard	229	
Void	5	
Total	234	
Ballots canvassed		3,883
Ballots withheld from canvass:		
From members in arrears of dues	52	
Without signatures	53	
With illegible signature	1	
Total withheld	106	106
Total number of ballots received		3,989

Respectfully submitted,

HARRY T. IMMERMAN, *Chairman*

Malcolm S. Spelman	H. F. Hormann	Frederick W. Ockert
A. C. Josephs	E. N. Whitney	C. P. Melioransky
Frank L. Greenfield	William H. Mueser	Ivan A. Rosov
Joseph Farhi	Harold W. Knox	*Tellers*

New Members of Division Executive Committees

EACH Technical Division of the Society is operated under an executive committee, members of which have overlapping terms. Yearly one member retires and another is appointed. Nominations for the new members are supplied by a nominating committee for each Division; up to three names are allowed for each vacancy.

From these suggested names the Board of Direction chooses the new member of each Division Executive Committee every year. Following this procedure, the Board considered the nominees for the various Divisions at its Cincinnati Meeting on October 14 and chose the following men, each for a term of five years:

DIVISION	NOMINEE
Construction	H. O. Locher
Highway	Roger L. Morrison
Hydraulics	John Q. Jewett
Irrigation	George H. Canfield
Power	Royce J. Tipton
Sanitary Engineering	N. T. Veatch, Jr.
Soil Mechanics and Foundations	Max C. Tyler
Structural	C. A. Ellis
Surveying and Mapping	S. S. Steinberg
Waterways	L. L. Hidinger

Designations not made by the Board at the Cincinnati Meeting were left to its Executive Committee. With other Society officers, these officers of the Divisions will take over their new duties in January 1941.

Authors Honored by Award of Society, Division, and Special Prizes

THE FALL OF THE YEAR brings considerable activity to the committees and subcommittees charged with the selection of papers that reveal outstanding contributions to the science and art of civil engineering in several categories of interest. The forms of recognition for this excellence of achievement have arisen in different ways and under the auspices of different groups or individuals within the Society. Most of these prizes will be presented at the Society's Annual Meeting in January. Student prizes are announced in conjunction with the Student Chapter news.

GENERAL SOCIETY PRIZES

Acting on the report of its Committee on Prizes, the Board of Direction at its Cincinnati Meeting authorized the granting of prizes for the current year to the following authors:

PRIZE	WINNER	TITLE OF PAPER
Norman Medal	Shortridge Hardesty, M. Harold E. Wessman, M.	Preliminary Design of Suspension Bridges
J. James R. Croes Medal	Edward J. Rutter, Assoc. M. Quintin B. Graves, Assoc. M. Franklin F. Snyder, Jun.	Flood Routing
Thomas Fitch Rowland Prize	J. D. Galloway, M.	Design of Rock-Fill Dams
James Laurie Prize	A. M. Rawn, M. A. Perry Banta, Assoc. M. Richard Pomeroy	Multiple - Stage Sewage Sludge Digestion
Collingwood Prize for Juniors	Kenneth D. Nichols, Jun.	Observed Effect of Geometric Distortion in Hydraulic Models

For these awards, selection was made from the various papers found in Volume 104 of TRANSACTIONS (1939). Ceremonies incident to the bestowing of these prizes will take place at the general sessions of the Annual Meeting of the Society in New York next January.

CONSTRUCTION ENGINEERING PRIZE

As recommended by the Construction Division and approved by the Board at its Denver Meeting, the Construction Engineering Prize for 1940 is to be awarded to Russell G. Cone, M. Am. Soc. C.E., for his paper, "Field Practice with Special Reference to Golden Gate Bridge," in the July issue of CIVIL ENGINEERING.

This is the second award of the Construction Engineering Prize, the first having been made last year. According to regular procedure, the bestowing of the prize will take place at the Society's Annual Meeting in January. It will be noted that the Construction Engineering Prize is separate from the other Society prizes, as it is under the direction of the Executive Committee of the Construction Division, and is limited to papers appearing in CIVIL ENGINEERING.

RUDOLPH HERING MEDAL

By approval of the Board of Direction at its Cincinnati Meeting, and in accordance with the recommendation of the award committee of the Sanitary Engineering Division, the Rudolph Hering Medal for 1940 is awarded to Joseph W. Ellms, M. Am. Soc. C.E., chairman of the Committee on Water Treatment Practice which formulated Society Manual No. 19, "Water Treatment Plant Design."

In making its recommendation, the Committee noted that it was acting "in recognition of a valued contribution to the literature and in outstanding service rendered the Sanitary Engineering Division and the profession at large—in particular, his several years of service as chairman of the Committee on Water Treatment Practice, which culminated in the production of a finished report which the Society has seen fit to reproduce in the form of a 'A Manual on the Design and Functions of Water Treatment Plants.'"

Although this prize is under the special patronage of the Sanitary Engineering Division, it is otherwise handled in a similar manner to the other Society prizes; that is, it is formally presented at the ceremonies incident to the Annual Meeting in January.

FIRST AWARD OF DANIEL W. MEAD PRIZES

Competition for the first award of the Daniel W. Mead Prizes was concluded with the year ending July 1, 1940. As a result of this year's operation, the awards are to be made as follows:

Daniel W. Mead Prize for Juniors, to Allen Jones, Jr., Jun. Am. Soc. C.E., of Knoxville, Tenn., with Honorable Mention to F. S. Glynn, Jr., Jun. Am. Soc. C.E., of Oswego, N.Y.

Daniel W. Mead Prize for Students, to Harry A. Balner of the George Washington Student Chapter (Washington, D.C.), with Honorable Mention to A. Collin of the University of California Student Chapter.

Rules for these prizes provide for a process of elimination by which selected papers are finally transmitted to the Society's Committee on Professional Conduct. The recommendations of that committee were the basis on which the Board confirmed the awards at its October meeting.

Aside from the honor of winning these prizes, the Junior award will include an allowance of $50 in cash as well as a certificate; and the student prize will yield $25 plus a certificate. The subjects for the competition just closed were as follows: for Juniors, "Ethics for Sales Engineers," and for Students, "Ethics for Engineering Students." Announcement has not yet been made as to the time and place of the presentation of these 1940 prizes, but it is expected that they will be given at Local Section or Student Chapter meetings or conferences. The competition for the 1941 award is now open.

Note for Wives and Daughters

IF THE MAN of the family is a member of the Society and does not have a Society badge, your Christmas problem is solved. Badges for members who have never owned them can be had on order without complication. For members who have lost their badges, a statement to that effect should accompany the order.

The badge for Honorary Members, Members, Associate Members, and Affiliates is blue enamel on solid 14-carat gold, the gold showing in the lettering and as a border around the shield. The price is $5, including the cost of engraving the member's name and grade of membership. The pin for Juniors is similar in shape and design, but is of 8-carat gold with a white border. It costs $2. The pin for Student Chapter members is gold filled and costs a dollar. Like the Junior pins, it has a white border, but is maroon where the other pins are blue. The Junior and student pins are not engraved, but all pins have safety catches. Badges may be had in the form of fobs or charms for watch chains, if preferred.

The badges must be ordered by December 1 if delivery is desired before Christmas. All orders should be sent to Society Headquarters, 33 West 39th Street, New York, N.Y.

National Defense Construction Program

October an Eventful Month

THE Third Supplemental National Defense Appropriation Act, 1941, for $1,482,000,000, which became law early in October, completes the current appropriation program of Congress. This bill, in large part, provides for outfitting and maintaining a peace-time army of 1,464,000 men and officers. It includes, however, a $10,000,000 graving dock for 45,000-ton ships in New York harbor; $5,000,000 for a Naval Supply Depot at Bayonne, N.J.; $3,000,000 for additional fields for carrier group pilots at the Naval Air Station, Corpus Christi, Tex. Only $75,000,000 of the appropriation in this bill is for Navy use; the balance is for the Army.

The passage of this bill disposes of all major defense legislation for this session of Congress. The total defense fund voted by Congress has reached $12,000,000,000, a sum without precedent in the nation's peace-time history. To this should be added authorizations for a $4,000,000,000 naval expansion program, funds for which have been voted to start building the two-ocean Navy.

The first Supplemental Civil Appropriations Act, 1941, also became law during October. As passed by the House, this bill, H. R. 10539, contained appropriations for $189,000,000. Of interest to engineers, the following items should be noted: $20,500,000 for Government office buildings in the District of Columbia to be awarded on competitive bidding, not by negotiated contracts; $40,000,000 to start the work of developing 250 civil landing areas having some military value, by the Civil Aeronautics Authority; $8,000,000 to the Corps of Engineers for unspecified rivers and harbors work; $4,000,000 to the Corps of Engineers for turbines and additions to the power plant at Bonneville Dam in Oregon; $2,500,000 to the Bureau of Reclamation for the Colorado River Project of Texas; $12,000 to the Alaska International Highway Commission for reconnaissance surveys on the Alaska–U.S. Highway.

DEFENSE HOUSING PROGRESS MADE

The Second Supplemental National Defense Appropriation Act, 1941 (Public 781), provided $100,000,000 for defense housing for the Army, for the Navy, and for the Maritime Commission. The proportion allocated to the Army is $45,762,500 to provide for 13,000 dwelling units. The Secretary of War has requested the Federal Works Agency to carry out the Army's share of the Defense Housing Appropriation. Already 70 projects have been designated to be constructed under the direction of the Public Buildings Administration of the Federal Works Agency. It is understood that the Navy will undertake to build their share of this appropriation through the agency of its own Bureau of Yards and Docks.

Another defense housing bill (H. R. 10412), known as the Lanham Bill, has also become law. It provides for $150,000,000 to be spent through the Federal Works Agency. The Public Buildings Administration, selected to carry out a part or all of this work, is now engaged in developing standardized plans which will produce the required speed and efficiency with minute and elaborate study being given to their first housing project at Fort Knox, Ky. Study is also being given to the extent that engineers, architects, and landscape architects in private practice may be needed and used to supplement the personnel now available in the Washington office of the Public Buildings Administration.

The size of the defense housing program has grown to 230,000 units, estimated to cost in the aggregate three quarters of a billion dollars. It is presently anticipated that approximately 40% of the defense housing work may be carried out by private capital. As far as possible the housing units will be built at Army posts—that is, on Government-owned property—but it is not believed that more than one-third of the total housing needed can be thus located on Government-owned property. One of the major problems in housing work on large tracts involves sewers, water supply, drainage, street paving, and other utilities.

CANTONMENT CONSTRUCTION UNDER WAY

During October, more than a score of contracts for the design and for the construction of cantonments have been awarded, totaling in the aggregate over $100,000,000. These contracts have been negotiated on a cost-plus-fixed-fee basis by the Quartermaster Corps of the Army. Rapid completion is being demanded to meet the needs of the selective service army.

AIRPORT CONSTRUCTION

The $40,000,000 appropriation to the Civil Aeronautics Authority, contained in the First Supplemental Civil Appropriations Act, 1941 (H. R. 10539), may be used only for the improvement of air fields, including runways, lighting, and so forth, and no part of the appropriation may be used for the acquisition of land or for buildings required on or near the airport. The 250 airports which are to be improved with the $40,000,000 appropriation are to be selected by a committee composed of the Secretary of War, Secretary of Navy, and Secretary of Commerce. The Civil Aeronautics Authority, through its small engineering department of 30 or more men, has been working on improvement plans for civil air fields for several years, and has developed plans for fields which may be included in the 250 to be improved with the funds made available by Congress. The construction itself is likely to be handled by WPA as in the past. This current $40,000,000 appropriation should be compared with the average annual WPA expenditure of $100,000,000 on civil airports through the past number of years.

WEST INDIES BASES

Preliminary investigations have been made by the Army and the Navy of the bases made available by Great Britain in exchange for the 50 destroyers. This work will be under the Corps of Engineers of the Army and the Bureau of Yards and Docks of the Navy. The recently established Eastern Division of the Corps of Engineers will be charged with this specific duty.

LISTS OF AVAILABLE ENGINEERS

Again the Local Sections of the Society are cooperating with local sections of other societies and with local engineering societies, in the compilation of lists of available engineers, designers, inspectors, draftsmen, surveyors, and others available for employment by the firms engaged by the Government to assist in carrying out the National Defense Construction Program. The rapid expansion of the program is creating a demand on the part of both engineering and contracting firms for access to the lists thus made available. Any member of the Society or other available engineer should make contact with the secretary

Forecast for November "Proceedings"

INVESTIGATION OF STEEL RIGID FRAMES

By Inge Lyse, M. Am. Soc. C.E., and W. E. Black, Jun. Am. Soc. C.E.

Tests on two riveted-steel rigid-frame models (scale 4 to 1), one with a fairly square knee section and the other with a large circular fillet at the inside corner of the knee.

RELIABILITY OF STATION-YEAR RAINFALL—FREQUENCY DETERMINATIONS

By Katharine Clarke-Hafstad

A constructive criticism affecting the hypothesis of station-year rainfall data, in which the author proposes to show how errors in station-year assumptions may affect the determination of frequencies.

CAVITATION IN OUTLET CONDUITS OF HIGH DAMS

By Harold A. Thomas, M. Am. Soc. C.E., and Emil P. Schuleen, Assoc. M. Am. Soc. C.E.

A description of cavitation studies on models of the conduit entrance of the Madden Dam, Panama Canal Zone.

of the Local Section of the American Society of Civil Engineers nearest to his location.

NAVY BOOKLETS AVAILABLE

The Navy Department, Bureau of Yards and Docks, has recently printed, and has available for distribution, a 50-page pamphlet, prepared by William M. Smith, special assistant to the Chief of the Bureau of Yards and Docks, entitled "Some Commentaries on Cost-Plus-a-Fixed-Fee Contract with Particular Reference to United States Navy Contracts Under the Bureau of Yards and Docks." Engineers and contractors who anticipate the administration or the execution of construction or engineering work under the cost-plus-a-fixed-fee form of contract will find this Navy Department booklet of great value. It may be obtained from the Navy through the Chief of the Bureau of Yards and Docks on application.

ENGINEERS AFFECTED BY FORTY-HOUR WEEK

The change to the 40-hour week under the Fair Labor Standards Act of 1938, became effective on October 24. Under its provisions, wages for overtime work, that is, in excess of 40 hours per week, must be paid at the rate of $1\frac{1}{2}$ time for such excess. This is of interest to engineers, because it applies to the employees of all engineering firms whose work is inter-state in character.

The Act exempted from its provisions men "employed in a bona-fide professional capacity." Public hearings earlier this year resulted in a ruling made in October by Colonel Philip B. Fleming, Administrator of the Wage and Hour Division, clarifying the meaning of the term "professional." According to his ruling, an employee in a professional capacity is one who receives more than $200 per month; whose work is predominantly intellectual in character and of a nature that cannot be accomplished in a standardized time; and who spends at least 80% of his week's time on work of a professional character.

In accordance with a resolution passed by the Board of Directors of the Metropolitan Section of the Society, this ruling "conforms with the spirit of the Act," and "will preserve for the low-paid engineering employee the protection against exploitation sought by the Act, while at the same time freeing the higher paid men whose work is largely professional from the restrictions that apply to those whose work comes under the Act."

Student Prizes Awarded

At the end of the 1939–1940 school year many of the Society's Local Sections made their annual presentations of awards to engineering students graduating with high scholastic honors from colleges and universities within their territories. The awards vary, consisting usually of payment of the recipient's initiation fee as a Junior in the Society and, in some cases, of his dues for one year. In all cases the awards are contingent on the favorable action of the Board of Direction upon the recipient's application for membership. Word of the following prize winners for 1940 has reached Society Headquarters:

NAME OF STUDENT	COLLEGE	LOCAL SECTION GIVING AWARD
Harry Aloysius Kotecki	University of Arizona	Arizona
Thomas Hunter McCrackin, Jr.	University of Kentucky	Central Illinois
Edward Maull	University of Illinois	Central Illinois
Alfred John Porteous	University of Illinois	Central Illinois
Charles Harold Kruse	Ohio State University	Central Ohio
George Arthur Morton	University of Cincinnati	Cincinnati
Charles Robert Ash	Ohio Northern University	Cleveland
Ersel Glen Lantz	Akron University	Cleveland
Bert Evan Mansell	Case School of Applied Science	Cleveland
(Miss) Clara Barnes	University of Colorado	Colorado
Leonard Paul Zick, Jr.	Colorado State College	Colorado
Ferrer L. Vettori	George Washington University	District of Columbia
Robert Viner	Catholic University of America	District of Columbia
Berney Beauchamp Cowden	University of Florida	Florida
Lucian Jefferson Harris	Georgia School of Technology	Georgia
Mark Marlin Gantar	Northwestern University	Illinois
Donald M. Graham	Lewis Institute	Illinois
George Parker Hanna, Jr.	Armour Institute	Illinois
Chancellor D. Montgomery	Rose Polytechnic Institute	Illinois
Louis Worley Schumm	University of Illinois	Illinois
Allen Roy Shackleton	Purdue University	Illinois
Hsieu-Hsiang Ku	Purdue University	Indiana
Francis Joseph Woodsmall	Purdue University	Indiana
John C. Atkins	State University of Iowa	Iowa
Robert Allen Schick	State University of Iowa	Iowa
William Arthur Gay	Cornell University	Ithaca
Dwight F. Metzler	University of Kansas	Kansas
George W. Vaught	Kansas State College	Kansas
David Knox Blythe	University of Kentucky	Kentucky
Joseph Wagoner Sheppard	University of Louisville	Kentucky
Alfred Thomas Cox	Lehigh University	Lehigh Valley
Reuben G. Uhler	Lafayette College	Lehigh Valley
William Fraser Tompkins, Jr.	Tulane University	Louisiana
Edward Kent Bebb	University of Maryland	Maryland
Wilbur Stewart McKay	Johns Hopkins University	Maryland
Joel Wiesenfeld	College of the City of New York	Metropolitan
Carlos Antonio Bejarano	Columbia University	Metropolitan
Michael Thomas Aquino, Jr.	Cooper Union	Metropolitan
Peter Homac	Newark College of Engineering	Metropolitan
Henry Wallace Fischer	New York University	Metropolitan
Robert Howard Cummings	Brooklyn Polytechnic Institute	Metropolitan
Kirk B. Florance	University of Nebraska	Nebraska
Adolph J. Trujillo	University of New Mexico	New Mexico
Robert Burton Provine	New Mexico State College	New Mexico
J. Bruce Espy	Yale University	Northeastern
Maurice Woxland (1st prize)	University of Minnesota	Northwestern
Herbert Gaustad (2d prize)	University of Minnesota	Northwestern
Charles Archibald (3d prize)	University of Minnesota	Northwestern
E. B. Stevenson	University of North Dakota	Northwestern
Dennison J. McMahon, Jr.	North Dakota State College	Northwestern
James C. Norman	South Dakota State School of Mines	Northwestern
Thomas Byron Schultz	South Dakota State College	Northwestern
Eldon Alkire Rogers	University of Oklahoma	Oklahoma
William Harvey Hall	Oklahoma Agricultural and Mechanical College	Oklahoma
George Allen Asplund	Oklahoma Agricultural and Mechanical College	Oklahoma
Gerard Joseph Cavanagh	Oregon State College	Oregon
Joseph Estell Havenner	Oregon State College	Oregon
Lawrence M. Mead, Jr. (1st prize)	Princeton University	Philadelphia
James Kenneth Hess (2d prize)	Pennsylvania State College	Philadelphia
Sidney Robin (3d prize)	Drexel Institute	Philadelphia
William James Dixon	Carnegie Institute of Technology	Pittsburgh
Robert Kenneth Schrader	University of Pittsburgh	Pittsburgh
Daniel Joseph Coonan, Jr.	Rhode Island State College	Providence
George Edward Wade	University of Nevada	Sacramento
Harold Ben Lockett	Washington University	St. Louis
Robert Neal Lorance	Missouri School of Mines and Metallurgy	St. Louis
George Posthumus	University of California	San Francisco
Stephen Edmund Graham	University of Santa Clara	San Francisco
Niels Jorgan Schultz, Jr.	Stanford University	San Francisco
Jack Ralph Benjamin	University of Washington	Seattle
Raymond Miller Gillespie	Clemson College	South Carolina
Charles Dunbar Black	University of South Carolina	South Carolina
John Francis Erdle	University of Idaho	Spokane
Vernon Eldon Godsey	Washington State College	Spokane
George Walter Hall	University of Tennessee	Tennessee
William Howard Magness	University of Tennessee	Tennessee
Vern Melvin Brown	University of Utah	Utah
Robert John Downey	Virginia Polytechnic Institute	Virginia
Fred Fort Flowers	Virginia Military Institute	Virginia
Roy Dorien	Marquette University	Wisconsin
David Hays	University of Wyoming	Wyoming
Mark Henderson	University of Wyoming	Wyoming

Other awards of Junior membership in the Society made at commencement time included a special prize awarded by the department of civil engineering at the Case School of Applied Science to Frank Porter Converse, Jr.; the Dam Club Prize given to Nathan Segal, of the College of the City of New York; and the Milo S. Ketchum Award, made by the civil engineering department of the University of Colorado, to Douglas Emeril Dreier, of the University of Colorado. The winner of the award presented by the New England Conference of Student Chapters was Walter B. Kelley.

Receipt of Foreign Technical Journals Interrupted by War

Engineering Societies Library Arranges to Store Publications in Country of Origin

ALTHOUGH technical magazines are being received regularly from Great Britain, only a few now reach the Library from continental Europe. The 350 or more from England have been delayed only by the loss of one or two batches sunk by torpedo or mine. These were quickly replaced by the publishers.

The flow of German magazines through Italy was stopped by that country's entrance into the War. By the first of October, a few were beginning to be received again through Siberia and Japan. *Genie Civil* and other French periodicals ceased arriving at the Library a few weeks after the surrender of France. To avoid loss of valuable publications being sent to and received from the British Isles and continental Europe through exchange agreements between engineering institutions there and the Engineering Societies Library and its cooperating organizations, arrangements have been completed to store them in the country of origin until the end of hostilities.

American Engineering Council

The Washington Embassy for Engineers, the National Representative of a Large Number of National, State, and Local Engineering Societies in 40 States

ENGINEERING EDUCATORS APPOINTED TO DEFENSE TRAINING COMMITTEE

TO ASSIST in the task of utilizing the facilities of engineering schools and colleges in the emergency training of workers for defense industries, John W. Studebaker, U.S. Commissioner of Education, has appointed a special advisory committee composed as follows: Chairman, Andrey A. Potter, dean of engineering, Purdue University; R. E. Doherty, president, Carnegie Institute of Technology; Gibb Gilchrist, dean of engineering, Agricultural and Mechanical College of Texas; H. P. Hammond, dean of engineering, Pennsylvania State College; W. O. Hotchkiss, president, Rensselaer Polytechnic Institute; R. S. McBride, consulting engineer; Thorndike Saville, dean of engineering, New York University; C. C. Williams, president, Lehigh University; B. M. Woods, chairman, department of mechanical engineering, University of California; F. L. Bishop, secretary, Society for the Promotion of Engineering Education; Allen W. Horton, Jr., U.S. Office of Education (secretary).

It will be the task of this committee to aid in devising ways and means of best utilizing the teaching staffs and plants of technical schools in presenting special courses, not necessarily for students of collegiate grade, designed to furnish special skills needed in carrying out the defense program. Funds for this purpose have already been appropriated.

MANY ENGINEERS INCLUDED IN DEFENSE PERSONNEL

When our country has an emergency defense job to do, who is called in to plan and execute the job? The answer is found in scanning the names of those who have been called in to staff the important departments of the Advisory Commission to the Council of National Defense, most of whom are engineers, or are skilled technicians in engineering or allied fields. If the engineering profession needed proof of its important standing in our scheme of national defense (which it doesn't), proof which is just about conclusive is to be found in the names and numbers of engineers now engaged in planning and executing our defense program. Engineers occupy the front-line trenches in this campaign of preparedness, other professions furnishing the necessary support, of course. This situation comes about naturally as a result of our need for equipping what today must be a mechanized army. The Navy, too, is of course highly mechanized.

Two important departments of the Advisory Commission are those headed by E. R. Stettinius, and William S. Knudsen. They deal with the procurement of raw materials and finished products, respectively. Most key positions are occupied by engineers. Ralph Budd heads the department of transportation and here, also, one finds a staff of engineers and experts in all forms of transportation—by land, water, and air. Lack of space forbids a detailed presentation of the facts, but a casual analysis of the setup in the three mentioned departments of the Defense Commission shows that engineers and other technologists in key positions constitute over 80% of the total, the remainder being in the legal and fiscal sections.

Some may suspect from the rates of payment by Uncle Sam to his engineer nephews that the engineering profession rates not as high as some others, but when national trouble seems to be coming our way, the hurried emergency call is for engineers—and more engineers! The profession can take pride in this; it can likewise derive much satisfaction in being permitted to use its collective talents in doing for our country that which is without question so desperately needed.

EMPLOYMENT PROCEDURE FOR ENGINEERS ON DEFENSE WORK

Engineers who wish to offer their services to the federal government in the defense program have three main avenues of approach: (1) direct employment, (2) engagement on a consulting basis, and (3) as an employee or consultant of a contractor having a government contract.

With relatively few exceptions, employment in government departments, bureaus, independent agencies and the like is under civil service rules and regulations. Competitive examinations produce so-called eligible lists, from which names are certified to those government agencies making requests. Personnel is being added to several agencies directly concerned with the defense program, such as War, Navy, and the Defense Commission, but most appointments are being made from Civil Service eligible lists already in existence. Many jobs are being handled by calling reserve officers of the Army and Navy to active duty. The chance of obtaining direct employment is somewhat remote for those not having civil service status or not in the organized reserves.

The engagement of engineers on a consulting basis is handled by each government agency in accordance with rules and regulations of long standing, although in a few cases recent simplifications to expedite procedure have been made. In general, compensation is on a per diem basis and only in exceptional cases does the rate exceed $25 per day. Many government agencies at times use consultants, but at present and in carrying out the defense program, the Army, Navy, and the Panama Canal are the principal agencies now taking on engineering consultants.

Applications for consulting work in the Army are being handled by the recently appointed Construction Advisory Board consisting of Francis Blossom, Forrest S. Harvey, and J. F. C. Dresser. Communications to this board should be addressed to 1125 Munitions Building, Washington, D.C. Requests for consideration should be accompanied by a full statement of experience records, especially records of jobs accomplished. Applications from engineering firms as well as from individuals may be sent to this board. A similar list for the Navy is being compiled by Lt. Commander E. J. Spaulding, Bureau of Yards and Docks, Navy Department, Washington, D.C.

Contractors on defense work will of course engage their own employees and consultants. The policy adopted by the government is to award contracts, whether for the consulting services of engineers, or for construction, to those qualified to handle the work and who reside in the region where it is to be done. In a few cases, the construction contract also includes the design, but this is exceptional. However, engineering firms who are also contractors might well make their qualifications known to the Construction Advisory Board named above.

CIVIL SERVICE EXTENDED

Eventual inclusion within the merit system of an estimated 200,000 positions in the federal service is possible if the House and the Senate, each of which has approved the Ramspeck Bill, can compose a dispute over its method of application. This measure authorized the President, by executive order, to cover under the Civil Service almost all federal agencies now not subject to its provisions. Notable exceptions are all employees of the Works Projects Administration and the Tennessee Valley Authority, assistant U.S. district attorneys, and positions filled by Presidential appointment and approved by the Senate.

Actual application of the new law would be extended over a considerable period of time in order to spread the load on the Civil Service Commission, which is required to give non-competitive examinations to present incumbents before they can be certified for permanent appointment. All who fail to pass these examinations must be dropped from the service within six months and their places filled from Civil Service registers of eligibles.

PENNSYLVANIA'S SUPERHIGHWAY OPENED

Highway construction practices of the future are forecast in the new four-lane divided Turnpike connecting Harrisburg and Pittsburgh, opened to traffic October 1. With no grade crossings, no traffic lights, and only ten points for ingress and exit, the 160-mile road penetrates the ranges of the Allegheny Mountains by means of seven tunnels that make possible a maximum grade of only 3% and the elimination of dangerous curvature.

The $70,000,000 project was made possible by financing through the Public Works Administration and the Reconstruction Finance Corporation, and will be operated as a toll road. The charge for passenger cars is $1.50 for the full route, with a special $2.25 round trip rate good for 30 days. Truck tolls range from $3 to $10. The route followed was laid out for the construction of a railroad over 50 years ago, which was abandoned before the completion of the tunnels.

CENSUS CONFIRMS SLACKENING IN POPULATION GROWTH

Preliminary figures based upon the recent decennial census indicate that on April 1, 1940, the continental United States had a total population of 131,409,881, according to a recent announcement by the Census Bureau. This indicates a net gain of 8,634,835 persons in the past decade, or 7%, as compared with 14% gain between 1920 and 1930. Barring radical changes in immigration policy, this indicates that the United States will probably reach a stable population of about 150,000,000 in 1970 or 1980, according to expert calculations.

During the last decade the southern and western states, as a whole, showed the most rapid rate of population growth. The industrial states of the Northeast, while still growing, fell below the national rate of increase, while the arid "Dust Bowl" area showed an actual loss in population. For the first time in history the center of population, which has moved steadily westward since the first census in 1790, will reverse its trend and move slightly to the Southeast.

Washington, D.C.
October 8, 1940

Appointments of Society Representatives

H. E. WESSMAN, M. Am. Soc. C.E., has been reappointed one of the Society's representatives on the Research Procedure Committee of the Engineering Foundation.

News of Local Sections

Scheduled Meetings

ALABAMA SECTION—Annual meeting November 29 and 30.

ARIZONA SECTION—Annual fall meeting at the Westward Ho Hotel, Phoenix, on November 23, at 9 a.m.

CLEVELAND SECTION—Luncheon meeting at the Guild Hall on November 12, at 12:15 p.m.

DAYTON SECTION—Luncheon meeting at the Dayton Engineers Club on November 18, at 12:15 p.m.

DISTRICT OF COLUMBIA SECTION—Meeting of the Junior Forum at George Washington University on November 24, at 8 p.m.

DULUTH SECTION—Luncheon meeting at the Kitchi Gammi Club on November 18, at 12 m.

ILLINOIS SECTION—Smoker of the Junior Section at the Chicago Engineers' Club on November 8, and dinner meeting of the Junior Section at the Central Y.M.C.A. on November 25, at 6 p.m.

INDIANA SECTION—Two-day meeting at the Anthony Hotel, Fort Wayne, on November 15 and 16, in conjunction with the 61st Annual Convention of the Indiana Engineering Council held jointly with the Indiana Society of Professional Engineers.

IOWA SECTION—Annual meeting at the Hotel Fort Des Moines, Des Moines, on November 21, at 2:30 p.m. and 6 p.m.

KANSAS SECTION—Dinner meeting at the Kansan Hotel on November 15, at 6:30 p.m.

LOS ANGELES SECTION—Annual ladies' night and dinner on November 13.

METROPOLITAN SECTION—Technical meeting in the Engineering Societies Building on November 20, at 8 p.m.; regular meetings of the Junior Branch in the Engineering Societies Building on November 13 and 27, at 7:30 p.m.

MIAMI SECTION—Dinner meeting at the Alcazar Hotel on November 7, at 7 p.m.

MOHAWK-HUDSON SECTION—Joint meeting with the consolidated engineering societies of Schenectady at the Old Chapel, Union College, on November 7, at 8 p.m.

NORTHEASTERN SECTION—Dinner meeting of the Junior Forum at M.I.T. Graduate House on November 12, at 6:30 p.m.

NORTHWESTERN SECTION—Dinner meeting at the Minnesota Union at the University of Minnesota on November 4, at 6:15 p.m.

PHILADELPHIA SECTION—Dinner meeting at the Engineers Club, Philadelphia, on November 12, at 6 p.m. (Meeting at 7:30 p.m.)

PITTSBURGH SECTION—Water conference held jointly with the Civil Section of the Engineers Society of Western Pennsylvania at the William Penn Hotel on November 12 and 13—9 a.m. to 4 p.m. on the 12th, and 9:30 a.m. to 5 p.m. on the 13th.

SACRAMENTO SECTION—Regular luncheon meetings at the Elks Club every Tuesday at 12:15 p.m.; dinner meeting of the Junior Forum at Harts Restaurant on November 13, at 6:30 p.m.

SAN FRANCISCO SECTION—Dinner meeting of the Junior Forum at the Engineers' Club on November 26, at 5:45 p.m.

SEATTLE SECTION—Dinner meeting at the Engineers' Club on November 25, at 6 p.m.

SPOKANE SECTION—Luncheon meeting at the Davenport Hotel on November 8, at 12 m.

TENNESSEE VALLEY SECTION—Annual meeting at Grove Park Inn, Asheville, N.C., on November 8 and 9.

TEXAS SECTION—Luncheon meeting of the Dallas Branch at the Dallas Athletic Club on November 4, at 12:10 p.m.; luncheon meeting of the Fort Worth Branch at the Blackstone Hotel on November 11, at 12:15 p.m.

Recent Activities

CENTRAL ILLINOIS SECTION—*Springfield, May 21:* Awards of Junior membership in the Society were presented to T. H. McCrackin, Edward Mauel, and A. J. Porteous. The speaker of the evening was T. M. Lowe, chief radio engineer of the Illinois State Police, who presented many facts concerning television, frequency modulation, and other aspects of radio communication. *Champaign, October 3:* The feature of the occasion was a talk on the new Illini Union Building recently constructed on the campus. This was given by John C. Leavell, architect on the structure.

CINCINNATI SECTION—*October 3:* This was a special meeting called for the purpose of giving the various committees working on the Fall Meeting program a chance to report. Director J. E. Root and H. W. Hanly gave short talks.

COLORADO SECTION—*Denver, September 9:* Following a dinner and discussion of the business affairs of the Section, the president of Colorado State College, Roy M. Green, was introduced. Mr Green's subject was "Some Theories of Credit Structure."

DAYTON SECTION—*September 16:* The technical program consisted of an illustrated talk on "Stream Pollution in Indiana," which was presented by B. A. Poole, chief sanitary engineer of the Indiana State Board of Health.

DISTRICT OF COLUMBIA SECTION—*Junior Forum:* Monthly meetings have been enjoyed by the Junior Forum during the past year. Among the speakers addressing these sessions were Prof. M. A. Pyle, of the University of Maryland; Frank L. Dieter, Arlington County (Virginia) planning engineer; and C. J. Potter, assistant to the chief of the marketing section of the Bituminous Coal Division of the U.S. Department of the Interior. There was sustained interest in the weekly bowling contests, and a picnic was enjoyed on one occasion.

GEORGIA SECTION—*Atlanta, September 9:* An illustrated lecture on the construction of the Tennessee River Bridge at Guntersville, Ala., was given by Erwin Harsch, senior bridge engineer for the Tennessee Valley Authority.

ILLINOIS SECTION—*Chicago, October 1:* Joint meeting with the Chicago Engineers' Club. The guest speaker was A. A. Nickman, of the Commonwealth Edison Company, who gave an illustrated lecture on "Recent Applications on Arc Welding and Building Construction." There was also a symposium on the proposed registration law.

INDIANA SECTION—*Indianapolis, October 4:* "Construction Features of the Watts Bar Dam" was discussed by Oren Reed, construction engineer for the Tennessee Valley Authority on this project. Following his talk, Mr. Reed showed a number of Kodachrome slides.

LEHIGH VALLEY SECTION—*Lehigh University, Bethlehem, Pa., September 30:* Demonstrations by members of the Lehigh University staff and the making and testing of welds comprised the "test night" program. An explanation of the research work currently in progress at the laboratory was then given by Prof. Bruce Johnston.

LOS ANGELES SECTION—*September 11:* A symposium on engineering seismology was the feature of the occasion. Harry W. Dennis, consulting engineer, opened the discussion with a résumé of the historical aspects of seismology, and Clarence J. Derrick, consulting engineer, followed with a description of the development of instruments used in recording earthquakes. The activities of the U.S. Coast and Geodetic Survey in connection with earthquakes were explained by Franklin P. Ulrich, chief of the Seismological Field Survey Section of the Survey, and R. R. Martel, professor of structural engineering at California Institute of Technology, concluded the symposium with a discussion entitled "Character of Data Needed for Rational Design of Earthquake Resistant Structures."

MARYLAND SECTION—*Baltimore, September 24:* There was a brief discussion of national defense, the principal speaker being Walter E. Jessup, Field Secretary of the Society, who told of his work in Washington during the past few months to protect the interests of civil engineers. The showing of three official U.S. Navy films and a talk on "The Value of Sea Power"—given by Lt. A. D. Hunter—concluded the meeting. Lieutenant Hunter, who is stationed at the Bureau of Yards and Docks in Washington, supplemented his talk with slides showing the work of the Bureau.

MIAMI SECTION—*October 3:* This dinner meeting was devoted largely to the business of the Section, though there was also some discussion of national defense.

NASHVILLE SECTION—*October 1:* The technical program consisted of a talk by Howard D. Schmidt, chief engineer of the Division of Sanitary Engineering of the Tennessee State Department of Public Health. Mr. Schmidt discussed the early history, development, and technical problems of the Division.

NEW MEXICO SECTION—*Albuquerque, September 25:* On this occasion the Section was entertained by the Student Chapter at the University of New Mexico. The speaker of the evening was Fred C. Scobey, principal irrigation engineer for the U.S. Department of Agriculture, who presented an illustrated lecture on the method of land classification developed under his supervision on the Pecos Investigation at Roswell, N.Mex.

NORTHWESTERN SECTION—*St. Paul, October 7:* "The Creation of Jobs Through Using Our Resources" was the subject of a talk by Hubert J. Miller, executive secretary of the Minnesota Resources Commission. Mr. Miller described the wealth of the state and explained what local communities are doing in cooperation with the Commission to sponsor and develop industries and create jobs.

PANAMA SECTION—*Balboa, C.Z., September 16:* The speaker of the evening was Howard W. Brod, hydraulic engineer, who explained the elements of hydrologic analysis and the technique that is used in modern practice. Mr. Brod illustrated his talk with slides made especially for the purpose.

PHILADELPHIA SECTION—*September 14:* A joint inspection of Philadelphia housing projects was made by the Section and the local branch of the American Public Works Association. The party of twenty-five was conducted through the Hill Creek Project and the Glenwood Project, both low-rental housing developments that incorporate many interesting features.

SACRAMENTO SECTION—*September 3, 10, 17, and 24:* The first of these four weekly luncheon meetings was devoted to the showing of a motion picture entitled "The Wonder World of Chemistry," which was presented by L. M. Hill, northern California representative of the E. I. du Pont de Nemours Company. The speakers at the other three gatherings were J. L. Mathias, highway engineer for the Public Roads Administration; Frank C. Balfour, supervising right-of-way agent for the California Division of Highways; and H. D. Eberhart, assistant professor of civil engineering at the University of California. *Junior Forum, September 11 and 18:* The topic of discussion at the regular meeting held on the 11th was "Insulation for Homes," which was presented by J. Yancey, representative of the Johns-Manville Company. The second of these sessions consisted of a field trip through the Materials and Research Laboratory of the California Division of Highways.

SAN DIEGO SECTION—*September 19:* A talk on "Sewerage Disposal—a Public Welfare Problem" comprised the technical program. This was given by Clyde C. Kennedy, consulting engineer of San Francisco. Director Charles T. Leeds was also present and gave a short talk on the aims of the Society for the forthcoming year.

ST. LOUIS SECTION—*September 23:* Following a luncheon and business discussion, Hymen Shifrin, consulting engineer of St. Louis, presented a paper on "Sanitary Conditions in the Metropolitan St. Louis Area," in which he showed the need of a coordinated plan for the region.

TACOMA SECTION—*September 17:* Bertram P. Thomas, president of the Section, reported on the Annual Convention at Denver, and numerous business matters were discussed. A talk on modern production methods in shipbuilding was then given by Phil Spaulding, production manager of the Seattle-Tacoma Shipbuilding Corporation.

TENNESSEE VALLEY SECTION—*Chattanooga Sub-Section, September 10 and October 8:* At the first of these sessions several committee reports were presented, and there was considerable business discussion. Then Erwin Harsch, senior highway bridge engineer for the Tennessee Valley Authority, gave an illustrated lecture on "The Raising of the Guntersville Bridge Across the Tennessee River." The speaker at the October meeting was S. R. G. Finley, general superintendent of the Chattanooga Electric Power Board, whose topic was "One Year of Public Power." *Knoxville Sub-Section, September 10:* The technical program consisted of a talk on the construction of the Tennessee River Bridge at Florence, Ala., given by M. E. Chapman, contracting engineer for the Virginia Bridge Company. Mr. Chapman, whose company built the bridge, supplemented his remarks with a technicolor motion picture showing details of construction.

TOLEDO SECTION—*September 24:* The speaker of the evening was James H. Lynch, Jr., division engineer in charge of construction of the Lake Erie Water Supply Project. Mr. Lynch discussed the unique methods used in constructing the trunk mains and intake crib for the city of Toledo, illustrating his talk with lantern slides.

UTAH SECTION—*September 7:* Joint inspection trip and meeting with the Utah Society of Professional Engineers and the Ogden Engineers Club. The group first visited the Deer Creek-Salt Lake Aqueduct, where E. O. Larson, construction engineer for the U.S. Bureau of Reclamation in charge of the Provo River Project, explained the details of the aqueduct. The party then inspected the concrete pipe manufacturing plant and visited the Deer Creek Dam, where Mr. Larson and L. R. Dunkley explained the features of design and construction. Dinner and a technical meeting, at which Mr. Larson discussed the Provo River Project, concluded the program. *September 21:* On this occasion a joint inspection trip was made with the Utah Society of Professional Engineers to Hill Field, the large air depot being constructed by the army south of Ogden as a supply, maintenance, and repair field for the air corps. *Junior Forum:* Members of the Forum joined the Utah Section and other groups in an inspection trip on September 7.

Data Compiled from 1940 Annual Reports of Student Chapters

JUST A YEAR AGO these pages carried a table of statistical data about the 123 Student Chapters, abstracted from their Annual Reports for the previous academic year. It is believed that this information for 1939–1940 will again be of interest to members of the Society, and the material accordingly appears on the following two pages.

Publication also draws merited attention to the means through which the Chapters are most successfully approaching the objective of all Chapters—to inculcate a measure of the professional point of view while the student is still in full pursuit of his formal technical training.

The thanks of all members of the Society should also go to the Faculty Advisers and Contact Members whose names appear after the Chapters they worked with last year. There is ample evidence from former years that the aid extended so generously by these men to the members of their respective Chapters has helped orient many a young engineer in his early years in our profession.

Name of Chapter	No. of Members	Aver. Attend. at Mtgs. (Members Only)	No. of Meetings	Total No. of Visitors During Year	No. of Papers or Lectures: By Students	By Faculty	By Others	Am. Soc. C.E. Illus. Lectures	No. Meetings Attended by: Fac. Adviser	Cont. Mem.	Membership by Classes: Freshmen	Sophomores	Juniors	Seniors	Grad. Stud.	% of Eligibles Who Are Members	Members of Faculty: In Soc.	Not in Soc.	Faculty Adviser	Contact Member
Akron, Univ. of	15	11	6	69	1	0	4	0	6	1	0	2	10	3	0	100	3	1	John Bulger	E. D. Barstow
Alabama Poly. Inst.	47	26	24	211	14	6	13	6	21	15	4	6	18	18	0	40	4	1	J. A. C. Callan	R. S. Garrett
Alabama, Univ. of	21	18	15	125	1	2	4	3	12	6	0	0	9	12	0	48	5	1	D. A. Du Plantier	A. C. Decker
Antioch Col.	17	20	10	5	0	3	2	0	10	0	0	3	5	9	0	26	1	0	R. A. Voelker	C. S. Bennett
Arizona, Univ. of	58	22	12	70	4	0	7	0	10	8	..	19	24	15	0	92	5	0	F. C. Kelton	J. H. Gardiner
Arkansas, Univ. of	32*	24*	16	12	26	1	2	2	15	2	0	0	20	12	0	46	2	2	W. R. Spencer	N. B. Garber
Armour Inst. of Tech.	40	38	10	..	0	3	6	3	10	2	0	8	16	16	0	70	..	..	R. L. Stevens	A. J. Hammond
Brooklyn, Poly. Inst. of	99	43	15	58	0	1	11	0	12	1	0	24	10	18	0	88	8	2	E. J. Squire	E. L. Macdonald R. W. Albrecht†
Brown Univ.	13	12	20	20	17	1	3	0	6	4	0	1	5	7	0	100	2	1	W. R. Benford	H. E. Miller
Bucknell Univ.	16	15	9	20	4	3	1	1	8	1	4	1	6	5	0	52	2	2	D. N. Griffith	J. T. Fetherston
California Inst. of Tech.	21	16	13	265	0	4	8	0	7	5	..	2	4	9	6	92	13	0	Franklin Thomas	H. W. Dennis
California, Univ. of	241	111	8	40	1	0	6	0	8	7	10	24	130	75	2	65	15	1	C. T. Wiskocil	J. I. Ballard
Carnegie Inst. of Tech.	50*	47*	32	205	16	1	15	1	31	0	0	18	15	17	0	100	7	0	F. M. McCullough	J. F. Laboon
Case School of Applied Sci.	46	26	11	114	8	2	7	0	10	4	0	18	16	12	0	100	6	0	G. E. Barnes	M. S. Brown
Catholic Univ. of Amer.	32	17	26	10	6	3	5	14	10	0	6	10	8	8	0	100	2	3	F. A. Biberstein, Jr.	R. W. Berry
Cincinnati, Univ. of	112	33	12	68	1	2	6	1	10	10	21	38	28	25	0	100	4	2	R. W. Renn	F. W. Morrill
Citadel, The	50	28	12	31	8	0	3	0	11	3	0	10	15	25	0	100	2	4	John Anderson	J. E. Gibson E. M. Fucik†
Clarkson College of Tech.	19	18	6	42	0	3	1	0	3	1	2	4	7	6	0	51	4	1	W. J. Farrisee	W. T. Field
Colorado State Col.‡	32	..	10	..	7	2	0	0	10	..	..	2	12	18	0	57	1	3	N. A. Christensen	R. L. Parshall
Colorado, Univ. of	76	49	15	238	39	0	3	0	14	4	..	15	24	37	0	62	8	0	C. L. Eckel	A. O. Ridgway Lee Crandall†
Columbia Univ.	24	18	23	82	11	0	8	0	22	1	0	0	5	14	5	100	11	1	J. K. Finch	E. P. Goodrich S. A. Olin†
Cooper Union	64	21	17	84	4	3	5	1	11	9	0	5	8	15	0	72	7	6	R. C. Brumfield	W. H. Yates W. C. Stevens†
Cornell Univ.	81	44	9	87	0	1	6	0	9	2	12	17	24	24	4	...	19	8	F. A. Barnes	H. E. Snyder
Dartmouth Col.	18	19[a]	26	16	18	0	3	0	25	0	0	0	0	9	9	90	3	0	W. P. Kimball	
Dayton, Univ. of	21*	21*	16	89	19	2	16	2	16	14	0	8	9	4	0	100	3	2	C. J. Belz	J. J. Chamberlain
Delaware, Univ. of	33	6	8	68	0	0	7	0	7	6	17	7	6	3	0	100	2	1	T. D. Mylrea	C. E. Grubb
Detroit, Univ. of	48	25	8	27	0	0	8	0	8	4	10	16	7	7	8	100	8	0	C. C. Johnston	Maurice Quinn
Drexel Inst. of Tech.	47	40	5	10	1	0	4	1	5	5	14	9	16[b]	8	..	59	4	3	S. J. Leonard	H. J. Stetina
Duke Univ.	20	18[c]	14	65	17	1	2	5	14	2	0	8	6	6	0	100	3	1	J. D. Watson	H. W. Kueffner
Florida, Univ. of	29	20	12	19	1	1	6	0	11	3	0	10	8	10	1	90	4	0	W. L. Sawyer	Donald Wallace
George Washington Univ.	24	11	10	125	2	0	6	0	10	2	3	6	11	4	0	41	2	2	C. H. Walther	J. D. Fitch
Georgia School of Tech.	82	35	18	6	3	0	2	0	4	4	0	15	41	26	0	64	3	3	C. D. Gibson	Lacy Seawell
Harvard Univ.	86	30	10	2100	0	4	10	0	7	3	0	1	2	11	72	100	10	0	Albert Haertlein	H. M. Turner
Idaho, Univ. of	45	22	14	7	0	1	4	5	12	1	11	9	10	15	0	59	5	2	I. N. Carter[d]	William Hughes
Illinois, Univ. of	179	91	15	115	0	3	10	0	12	8	16	26	46	91	0	67	56	0	J. E. Buchanan J. J. Doland W. C. Huntington[e]	W. D. Gerber
Iowa State Col.	344	42	12	130	0	1	8	0	11	1	61	45	31	35	0	100	26	3	Frank Kerekes	M. B. Morris M. S. Berry†
Iowa, State Univ. of	33*	29*	32	80	20	3	13	9	27	1	0	0	17	16	0	97	13	0	E. L. Waterman	R. G. Kasel M. J. Webster†
Johns Hopkins Univ.	30	27	8	106	0	0	6	0	8	0	0	10	10	10	0	73	6	1	T. F. Comber, Jr.	W. T. Ballard
Kansas State Col.	89*	50*	19	562	2	1	15	0	18	6	..	11	30	45	3	93	8	2	M. W. Furr	W. E. Baldry M. H. Davison†
Kansas, Univ. of	33	19	15	194	4	1	7	1	15	3	..	6	15	12	0	75	8	0	G. W. Bradshaw	C. K. Mathews
Kentucky, Univ. of	81*	81*	25	4	12	9	5	2	25	0	0	45	25	11	0	..	4	1	W. J. Carrel	J. S. Watkins
Lafayette Col.	24	8	3	0	0	0	2	7	1	0	0	11	5	8	0	75	5	1	E. H. Rockwell	L. M. Entrekin
Lehigh Univ.	33	23	5	51	1	0	4	0	5	4	5	4	7	17	0	46	6	2	H. G. Payrow	L. M. Entrekin
Lewis Inst.	19	19	9	9	0	0	1	6	9	1	0	8	7	1	2	70	2	1	E. C. Shuman	Fred Gordan
Louisiana State Univ.	34	21	10	250	4	0	1	0	4	1	0	3	17	14	0	77	6	0	F. F. Pillet	N. E. Lant
Louisville, Univ. of	12	12	16	82	16	0	2	0	11	4	0	5	5	2	0	100	3	1	W. R. McIntosh	W. W. Sanders
Maine, Univ. of	30	18	6	19	2	1	3	1	5	3	0	3	12	15	0	52	2	4	W. S. Evans	H. L. Doten
Manhattan Col.	64	45	12	75	1	1	5	1	3	1 2	0	26	19	19	0	100	4	3	J. J. Costa	A. V. Sheridan J. J. Lanigan†
Marquette Univ.	33	21	9	73	1	0	6	0	8	2	0	1	16	16	0	27	1	2	O. N. Olson	L. D. Knapp
Maryland, Univ. of	34	23	10	115	2	0	6	0	8	0	0	0	18	16	0	95	4	2	S. S. Steinberg	H. H. Allen
Mass. Inst. of Tech.	61	31	7	15	6	0	2	1	7	1	0	17	18	23	3	94	23	8	J. D. Mitsch	S. M. Ellsworth
Mich. Col. of Min. & Tech.	27	18	8	280	2	1	2	2	8	0	11	3	5	8	0	56	3	5	W. C. Polkinghorne	L. F. Levin
Michigan State Col.	43	21	30	70	35	0	8	0	24	4	0	2	20	21	0	41	6	7	C. L. Allen	H. L. Conrad
Michigan, Univ. of	64	30	14	534	3	9	2	0	30	13	0	8	21	28	7	53	18	0	L. C. Maugh	D. C. May
Minnesota, Univ. of	139	45	11	6	0	5	1	0	6	4	0	41	45	53	0	89	9	5	A. S. Cutler	H. M. Hill
Mississippi State Col.	50	33	7	7	7	1	6	0	6	2	0	0	17	33	0	100	3	1	J. C. Bridger	N. H. Rector
Mississippi, Univ. of	37	26	13	30	3	1	9	1	6	1	11	9	12	5	0	73	2	1	A. B. Hargis	F. V. Ragsdale
Mo. School of Mines & Met.	42	27	13	630	8	0	11	0	13	0	0	3	21	18	0	48	5	1	E. W. Carlton	H. C. Beckman Clarence H. Ax†
Missouri, Univ. of	51	34	10	10	0	1	8	0	8	1	0	13	21	13	4	67	5	2	H. Y. Rubey	H. E. Frech
Montana State Col.	23*	19*	28	5	52	2	1	9	10	0	..	1	12	10	0	96	0	2	L. D. Conkling	F. M. Brown
Nebraska, Univ. of	37	23	10	59	2	2	5	1	6	2	..	..	19	18	0	50	4	1	C. E. Mickey	J. G. Mason J. V. Risser†

NAME OF CHAPTER	No. of Members	Aver. Attend. at Mtgs. (Members Only)	No. of Meetings	Total No. of Visitors During Year	No. of Papers or Lectures: By Students	By Faculty	By Others	Am. Soc. C.E. Illus. Lectures	No. Meetings Attended by: Fac. Adviser	Cont. Mem.	Membership by Classes: Freshmen	Sophomores	Juniors	Seniors	Grad. Stud.	% of Eligibles Who Are Members	Members of Faculty: In Soc.	Not in Soc.	Faculty Adviser	Contact Member
Nevada, Univ. of	19	10	6	195	0	0	6	1	6	3	2	4	6	4	3	54	2	1	F. L. Bixby	C. L. Hill
New Hampshire, Univ. of	22[f]	20*	20	105	16	3	6	0	17	0	0	0	11	11	0	100	4	0	E. W. Baler	L. F. Johnson
New Mexico State Col.	15[g]	..	13	8	7	0	0	5	13	1	..	2	7	6	0	47	2	0	D. B. Jett	W. W. Baker
New Mexico, Univ. of																				
New York, Col. of City of	49	24	27	0	1	2	11	0	12	1	0	0	8	41	0	70	13	2	C. Cunningham	D. B. Steinman W. J. Armento†
New York Univ.	93	29	23	49	1	3	8	1	21	8	0	18	26	17	0	73	9	1	D. S. Trowbridge	A. G. Hayden Vincent Cartelli†
Newark Col. of Eng.	43	30	9	67	0	1	6	0	9	9 3 2	0	6	16	11	0	94	7	2	W. S. La Londe, Jr.	Charles Gilman R. H. Gilman†
North Carolina State Col.	50	31	16	58	5	3	3	1	3	2	0	13	22	14	1	67	4	2	C. L. Mann	T. S. Johnson
North Dakota State Col.	36	28	18	134	7	2	9	2	17	1	3	6	12	15	0	68	1	2	R. T. Jennings	Edward Comm
North Dakota, Univ. of	21	13	13	112	6	3	5	2	13	0	..	..	10	11	..	78	3	0	Alfred Boyd	Clifford Johnson
Northeastern Univ.‡	65	21	5	78	1	0	0	0	5	1	..	14	36[h]	15	0	56	2	4	E. A. Gramstorff	M. N. Clair
Northwestern Univ.	24	18	7	57	1	2	3	0	7	2	6	3	5	10	0	62	4	2	L. T. Wyly	Albert Smith
Norwich Univ.	32	23	10	60	2	2	3	2	10	3	8	9	6	9	0	39	1	2	A. D. Taylor	T. W. Dix
Ohio Northern Univ.	32*	26*	15	23	20	3	6	0	14	0	9	6	8	9	0	100	2	0	A. R. Webb	Frank Gorman
Ohio State Univ.	64	28	12	42	1	1	4	2	5	2	1	14	15	34	0	41	10	1	C. T. Morris	F. D. Stewart C. H. Shepard†
Oklahoma A. & M. Col.	54	31	12	31	0	4	7	0	10	1	4	9	14	27	0	55	6	4	R. G. Saxton	V. H. Cochrane
Oklahoma, Univ. of	35	25	10	52	3	1	4	0	9	1	..	7	12	16	0	67	2	2	J. F. Brookes	L. M. Bush H. B. McInerney†
Oregon State Agri. Col.	95	45	8	37	0	1	6	0	8	2	..	32	28	35	0	68	4	5	G. W. Holcomb	G. H. Canfield
Pennsylvania Mil. Col.	28	14	8	30	0	2	6	0	8	0	13	6	7	2	0	100	2	1	Robert De Moyer	J. A. Shryock
Pennsylvania State Col.	65	39	11	95	4	3	6	0	9	5	7	11	21	26	0	70	7	9	J. S. Leister	H. J. Crumlish
Pennsylvania, Univ. of	27	17	9	6	3	0	4	3	6	4	5	4	9	9	0	64	5	2	H. C. Berry	Julius Adler
Pittsburgh, Univ. of	29*	47*	27	3	2	4	0	2	26	0	0	13	8	8	0	94	3	4	L. C. McCandliss	N. B. Jacobs
Princeton Univ.	15	13	5	75	1	0	3	0	5	0	0	0	5	8	2	56	5	0	Elmer K. Limby	Montgomery B. Case
Purdue Univ.	140	72	10	100	4	2	9	1	9	2	0	36	42	62	0	70	18	10	C. A. Ellis	M. R. Keefe
Rensselaer Poly. Inst.	41	26	5	475	0	1	4	0	5	0	0	8	13	15	5	37	6	2	Horace Compton	John Newton
Rhode Island State Col.	25	20	11	20	1	1	5	0	8	0	0	10	11	4	0	96	2	1	Frank Stubbs, Jr.	J. L. Murray
Rice Institute	20	11	13	20	12	0	7	0	3	3	..	11	6	3	0	74	1	1	L. B. Ryon, Jr.	J. H. Bringhurst
Rose Polytechnic Inst.	20	18	6	15	2	2	2	0	6	0	0	9	5	6	0	100	3	0	R. E. Hutchins	Fred Kellam
Rutgers Univ.	14	9	7	50	1	0	3	0	4	1	2	4	3	4	1	38	2	3	H. N. Lendall	Morris Goodkind
Santa Clara, Univ. of	23	11	10	13	4	1	2	1	10	0	8	5	7	3	0	100	2	1	E. C. Flynn	M. H. Antonacci
S.C., Clemson A.&M.Col of	62	36	16	10	6	3	2	0	12	0	0	11	24	27	0	87	3	1	H. E. Glenn	D. T. Duncan
South Carolina, Univ. of	28	18	18	10	4	1	1	2	3	1	0	3	17	8	0	..	3	0	W. E. Rowe	T. K. Legaré
South Dakota State Col.	25	15	8	22	3	1	1	1	7	0	3	7	8	6	1	69	3	0	H. B. Blodgett	
S. Dak. State Sch. of Mines	30	19	8	21	0	1	2	4	7	1	..	7	8	15	0	88	2	0	E. D. Dake	A. A. Chenoweth
Southern Calif., Univ. of																				
Southern Methodist Univ.‡	30	18	7	55	5	1	1	0	6	0	4	4	18	4	0	..	2	1	Sophus Thompson	L. R. Ferguson
Stanford Univ.	33	14	22	111	3	0	9	0	14	0	..	..	5	14	14	85	8	5	H. A. Williams	A. L. Trowbridge
Swarthmore Col.	22	16	9	60	6	0	3	0	9	0	10	2	4	6	0	100	2	0	S. T. Carpenter	Barclay White
Syracuse Univ.	35	19	7	0	5	1	0	2	5	0	0	14	10	7	4	100	5	0	C. S. Camp	G. D. Holmes
Tennessee, Univ. of	33	26	14	125	2	2	4	0	14	4	0	14	9	9	1	69	6	1	N. W. Dougherty	A. S. Fry H. deL. Southerland†
Texas, A. & M. Col. of	116	51	18	66	7	4	6	0	17	3	18	27	30	40	1	40	12	0	J. T. L. McNew	O. A. Seward, Jr.
Texas Tech. Col.	28	17	11	16	4	1	3	3	9	3	3	8	9	8	0	34	5	2	E. V. Middleton	H. N. Roberts
Texas, Univ. of	71	30	16	22	3	3	11	0	15	8	8	14	24	25	0	33	10	0	J. A. Focht	P. A. Welty
Tufts Col.	17	16	10	9	1	0	3	1	9	0	0	0	10	7	0	47	5	2	F. H. Crabtree	J. S. Crandall
Tulane Univ.	33	20	29	718	5	0	5	3	5	3	2	16	6	9	0	100	1	..	Donald Derickson	E. S. Bres
Union Col.	21	24	5	5	0	0	4	0	4	3	0	7	8	6	0	66	4	2	W. C. Taylor	H. V. Gulick C. W. Davies†
Utah State Agr. Col.	58	..	8	..	1	2	3	2	4	1	4	5	28	21	0	39	5	0	G. D. Clyde	O. C. Lockhart
Utah, Univ. of	98	73	18	51	3	0	7	3	11	2	37	28	17	16	0	87	3	2	A. Diefendorf	F. H. Richardson
Vanderbilt Univ.	22	..	9	0	10	2	3	..	..	..	..	..	..	..	..	..	..	..	W. A. Coolidge	A. J. Dyer
Vermont, Univ. of	17	12	8	110	3	1	1	0	3	0	0	6	4	7	0	..	2	2	G. F. Eckhard	D. W. Overocker
Villanova Col.																				
Virginia Mil. Inst.	173	175*	12	20	34	0	14	0	12	2	0	78	39	56	..	100	3	3	J. A. Anderson	E. M. Hastings
Virginia Poly. Inst.	71	..	13	0	2	2	2	3	7	0	0	12	21	38	0	87	3	3	R. B. H. Begg	F. P. Turner
Virginia, Univ. of	13	12	8	5	6	0	3	0	8	3	0	2	6	4	1	60	2	0	E. W. Saunders	A. J. Saville
Washington, State Col. of	52	28	13	15	4	7	4	0	12	6	15	7	13	17	0	63	3	2	C. L. Barker	T. H. Judd
Washington Univ.	22	13	8	53	1	0	2	1	5	1	0	7	4	9	2	92	4	1	E. O. Sweetser	J. E. Vollmar
Washington, Univ. of	79	37	12	37	3	2	4	0	8	4	..	5	17	57	0	63	13	3	F. H. Rhodes, Jr.	W. D. Shannon
West Virginia Univ.	19	12*	31	5	52	3	3	5	31	2	0	0	13	6	0	100	5	1	R. E. Nelson	H. O. Cole
Wisconsin, Univ. of	103	34	11	42	3	2	3	1	5	1	20	20	24	34	5	48	7	7	L. F. Van Hagan	C. N. Ward
Worcester Poly. Inst.	36	24	6	12	6	1	4	0	6	4	0	9	16	11	0	..	7	0	C. F. Meyer	Joseph Tosi
Wyoming, Univ. of	73	53	14	39	5	4	5	2	14	2	..	27	25	21	0	100	4	1	H. T. Person	E. N. Nelson R. A. Campbell†
Yale University	12	12	11	1527	2	1	2	1	8	2	0	0	5	7	0	100	6	0	R. H Suttie	C. E. Smith Grant Robley†

* Indicates compulsory membership or attendance; all others are on a voluntary basis.
† Junior Contact Member.
‡ Application approved January 16, 1940.
[a] Compulsory for 18 seminar meetings. Voluntary for 8 seminar meetings.
[b] Includes 7 Pre-Juniors.
[c] Voluntary except Seniors.
[d] I. N. Carter died April 8, 1940. Dean Buchanan acted until end of year.
[e] Acted as Faculty Adviser during Prof. Doland's absence for the second semester.
[f] Compulsory for Juniors and Seniors.
[g] Compulsory for Seniors only.
[h] Includes 17 "middlers."

Twelve Student Chapters Receive Special Commendation for Year's Work

FOLLOWING its annual custom the Society's Committee on Student Chapters has selected the Chapters whose work for the past school year has been found worthy of special mention. It is especially fitting that the announcement should appear in this November issue, for the annual reports of most of the Chapters are also summarized at this time. These summaries and a carefully prepared tabular record of the Chapter activities appear at the end of the Society Affairs section.

On the basis of the annual reports submitted by the student secretaries, the Committee on Student Chapters chooses twelve groups that merit special recognition. Three Chapters from each of the four Zones are thus selected to receive a "Letter of Commendation" from the President of the Society. The list for the year 1939–1940, as approved by the Board of Direction on October 15, follows:

Southern Region:	Tulane University Johns Hopkins University Virginia Military Institute
Western Region:	University of Washington University of Utah Agricultural and Mechanical College of Texas
North-Central Region:	University of Illinois Pennsylvania State College Purdue University
Eastern Region:	Columbia University Brown University New York University

Student Chapter Annual Report

For the School Year 1939–1940

UNIVERSITY OF AKRON

"The main objective of our Student Chapter for the year just completed was to bring the engineering student into closer contact with the engineer in practice.

"On May 10th there was a dinner meeting of the Cleveland Section held jointly with the Chapters from Case, Ohio Northern, and the University of Akron at the Case Club in Cleveland. After a very fine meal, the graduating seniors presented short talks on their respective theses. Junior memberships were presented to the outstanding seniors from each school. These joint meetings are well conducted, and our Chapter looks forward to them each year."

UNIVERSITY OF ALABAMA

From the beginning of school to the end of May, the University of Alabama Chapter was engaged in interesting activities that caused the 21 active members to take an increasing part in the work of the Chapter.

The Chapter was organized as soon as possible after school began. Meetings were held twice monthly, on the first and third Mondays, the first Monday being devoted to an outside speaker or to some program other than student presentations. The speakers chose subjects of interest to the students and held open discussion periods after the lectures. The second meeting of the month was given over to the showing of slides and motion pictures, or to student papers and discussions.

ALABAMA POLYTECHNIC INSTITUTE

The Chapter at Alabama Polytechnic Institute states that the 1939–1940 school year was one of the most successful in its existence. Several interesting meetings featured Society lantern lectures, followed by discussions of the project shown.

The school spirit was well demonstrated by the Chapter's interest in Engineers' Day. No prizes were awarded for the exhibits, but many compliments were given the display of the Chapter, the high lights of which were models of a proposed railroad underpass and of various types of bridges.

ANTIOCH COLLEGE

The Student Chapter at Antioch College has had difficulty from the first because of the cooperative character of the engineering course. The engineering student, particularly the upper-classman, having spent six months in the field, felt that on the campus he would rather devote his extra time to other than engineering activities. In consequence but few of those eligible joined the Student Chapter, and it was decided that the best interests of all would be served by the present abandonment of the Chapter.

UNIVERSITY OF ARIZONA

Planned organization, a well-rounded program, and wholehearted cooperation between advisers, officers, and members made the Chapter once again the outstanding professional organization on the Arizona campus. Chapter objectives were broadened by the development of outside contacts and the general preparation of its membership for a practical attitude toward engineering service and employment.

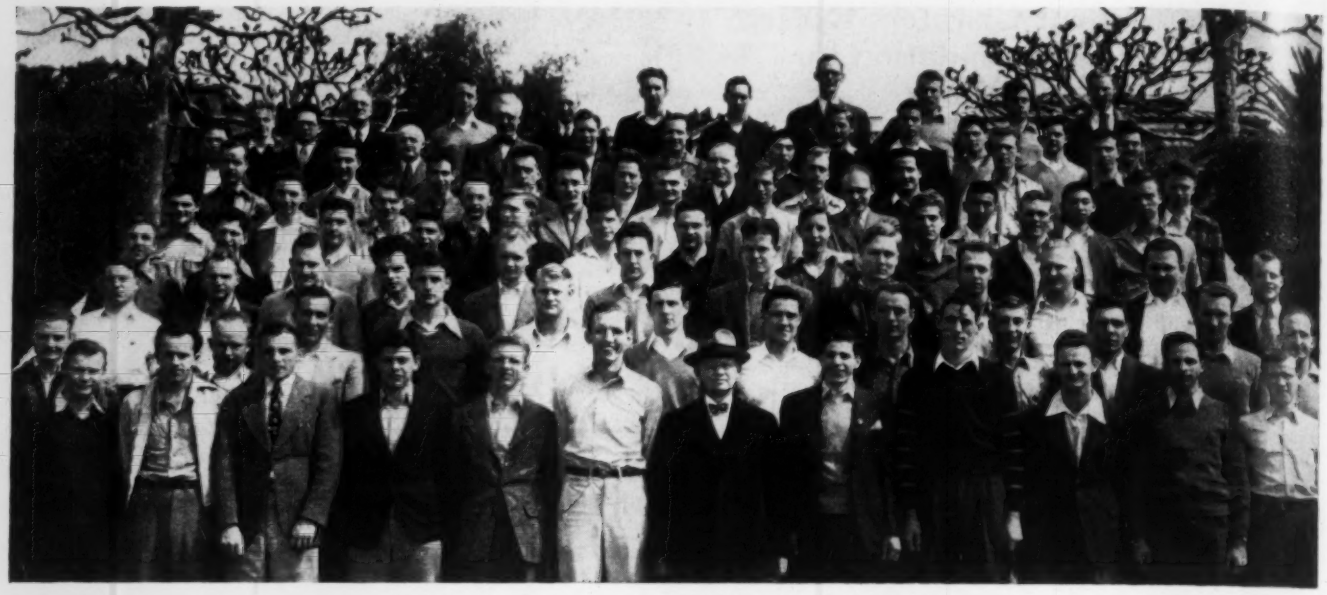
High lights of the year's activities were joint meetings with the University of New Mexico Student Chapter and with the University of Arizona Home Economics Club; participation in two meetings with the Arizona Section of the Society and in the Arizona Roads and Streets Conference; and the winning of awards for campus activities.

SOFTBALL TEAM OF THE UNIVERSITY OF ARIZONA CHAPTER
Champions of the Engineering College

The operation of the Chapter is in the hands of its officers, but guidance by Faculty Adviser Kelton, and the keen interest of John H. Gardiner, Contact Member, contributed much to the year's success.

UNIVERSITY OF ARKANSAS

The activities of the University of Arkansas Student Chapter got off to a good start on October 15 with a smoker, at which President Hall explained the purpose and organization of the Society to the new members. The presentation of student papers began with the meeting of October 25.



MEMBERS OF THE UNIVERSITY OF CALIFORNIA CHAPTER

Twelve members of the senior class, accompanied by Professors Spencer, Wray, and Vandewelde, made an inspection trip to Pensacola Dam on October 28. The class was shown around the project by V. H. Cochrane, alumnus of the university, who was one of the designing engineers. Eight members of the Chapter attended the meeting of the Mid-South Section of the Society held in Little Rock on April 29 and 30. At this time visits were made to the offices of the State Highway Department and of the U.S. Engineers.

ARMOUR INSTITUTE OF TECHNOLOGY

The Armour Institute Student Chapter had a highly successful year, with ten interesting meetings. In addition to this, it was host to several Chapters at the Third Midwest Conference of Student Chapters. It was decided to make the conference an annual affair.

BROWN UNIVERSITY

At most of the Chapter meetings the speakers have been students. The Chapter has cooperated in securing outside speakers

MEMBERS OF THE BROWN UNIVERSITY STUDENT CHAPTER WITH FACULTY ADVISER AND CONTACT MEMBER

for joint meetings under the auspices of the Brown Engineering Society.

BROOKLYN POLYTECHNIC INSTITUTE

Day Section: Meetings are held during chapel hour or during lunch hour: Refreshments are served, and the gatherings provide the best possible means for upper and lower classmen to become acquainted. Three inspection trips were made—two to nearby points and one to Boston and vicinity.

Evening Section: A separate evening section of the chapter is maintained because evening students are unable to attend meetings in the daytime. The Chapter meetings also furnish an admirable opportunity for evening students to make acquaintances in the school.

BUCKNELL UNIVERSITY

The outstanding achievement of the Chapter during the past year was initiation of a Chapter paper called "On the Level." This publication is intended to be a means of reporting activities of the Chapter and its alumni and perhaps of publishing technical articles.

UNIVERSITY OF CALIFORNIA

With a membership of 241, the University of California Student Chapter is the largest in the Western group. The students showed initiative in promoting, planning, and carrying out Chapter activities, which included smokers, dinner meetings, room meetings, a picnic, and inspection trips to the Alameda Naval Air Base and to the plants of the Columbia Steel Company and the California Corrugated Culvert Company. Outside speakers, prominent in the profession, were obtained for most of the meetings of the Chapter.

The Chapter membership is prominent in campus affairs, particularly in the activities of the college of engineering. This is the more creditable because the university is located in a metropolitan area where many students live at home, many miles from the campus.

CALIFORNIA INSTITUTE OF TECHNOLOGY

Due to small enrolment in undergraduate classes, and increased emphasis on graduate work, the numerical size of the California Institute of Technology Chapter is small. However, interest in the Student Chapter is keen as evidenced by an average attendance at meetings of 75% of the membership.

During the year six inspection trips were enjoyed. Programs of regular meetings, at which outside speakers predominated, were planned to stimulate a broad interest in the civil engineering field. Chapter members frequently attend meetings of the Los Angeles Section, and evince keen interest in applying for membership in the Society. These values are believed to be important aspects of an engineer's education and are stressed by the Faculty Adviser and Contact Member.

CARNEGIE INSTITUTE OF TECHNOLOGY

"The Student Chapter of the Society at Carnegie Institute has completed another active and productive year. Our good fortune in securing many speakers who have dealt with a wide variety of civil engineering subjects has made this year very profitable to the students. We have given special effort to outside activities that increase student interest because we firmly believe that the success of the Student Chapter depends on the interest and cooperation of every student and faculty member."

UNIVERSITY OF DAYTON

"The primary objectives of the civil engineering department, succinctly expressed in 1919 by Dr. Bernard T. Schad, head of the department, are carefully pursued to this day: (1) The training of students in the solid fundamentals of the technical engineering subjects; (2) a cultural broadening of the engineering students by the insertion in the curriculum of a well-balanced series of humanistic subjects; and (3) the development of a 'professional consciousness' in the embryonic engineers.

"The faculty of the department of civil engineering thoroughly believes that the third objective is best achieved through the medium of the Student Chapter. Accordingly, all sophomores, juniors, and seniors are required to attend the bi-weekly meetings. One credit is given at the end of the senior year to students who for six semesters have satisfactorily participated in the Chapter's activities."

THE UNIVERSITY OF DAYTON CHAPTER IN THE CLASSROOM

CASE SCHOOL OF APPLIED SCIENCE

"The programs presented this year were well balanced as to educational and entertainment value. The Chapter was fortunate in obtaining speakers who rank high in their respective fields. It was gratifying to realize that these men were willing to speak before the Chapter because, in no small measure, it showed the interest the men in the field have in young engineers. We feel that this is due largely to our affiliation with the Society.

"The interest shown in the lectures by these qualified speakers was demonstrated by the number and variety of questions asked by members of the Chapter."

DREXEL INSTITUTE OF TECHNOLOGY

With a considerably increased membership this year, the Drexel Institute Chapter assumed and successfully carried out several new activities. One of these was the publication of a Chapter paper.

CATHOLIC UNIVERSITY OF AMERICA

This Chapter is governed by a constitution modeled after the one suggested in the "Manual for Student Chapters," with certain modifications due to the fact that all campus organizations are under the supervision of the Inter-Club Council. Membership in the Chapter is voluntary. The architectural engineers have displayed a keen interest in the activities of the Chapter, and students enrolled in the architectural engineering courses constitute 20% of the membership of the Chapter. Regular meetings were held on the first and third Wednesday evening of every month. A concerted effort is being made by the various organizations on the campus to hold their regular meetings at fixed times in order to avoid conflicts. It has been proved that rigid adherence to the policy of regular fixed meetings does not tend to lessen the interest of the members. In addition to the regular meetings, the noon hour every Friday is reserved for presenting activities sponsored by the university engineering societies.

THE CHAPTER AT DREXEL INSTITUTE OF TECHNOLOGY

In January a group of senior civil engineers attended the Annual Meeting of the Society in New York, where they enjoyed the continuous round of meetings, speeches, banquets, and field inspection trips in and around New York City.

UNIVERSITY OF CINCINNATI

"During the past year, the Student Chapter of the Society at the University of Cincinnati has become alive, and has made a real name for itself on the campus. It has entered activities never before attempted in the organization. It has left them well done.

"The cooperative system here at Cincinnati makes the operation of a Chapter quite difficult at times, but the problems confronting us are gradually being solved."

THE CITADEL

The Citadel Chapter has successfully completed its second full year of existence—it was organized in January 1938. The Chapter has now firmly established itself as one of the leading campus organizations and is progressing toward even greater prominence in both student and professional circles. During the past year it has inaugurated a program designed to bring its members into closer contact with the professional man in the field and the student in the classroom. Efforts have been made to impress upon the general public the active interest in civil engineering within the Chapter and the work that the Chapter is doing in emulating the professional and ethical standards of the Society.

CLARKSON COLLEGE

"Our Contact Member, William T. Field, proved to be a real friend. He was always ready to give some of his valuable time to the Chapter. As a guest speaker he could be counted on to deliver a speech of interest to all present. At the banquet held May 16, Mr. Field spoke on 'The Engineer's Place in the Community.' He stressed the fact that the modern engineer cannot afford to isolate himself from other members of his community. He must be a good mixer, and do work that will benefit society and not just enhance his own personal reputation.

"There was nearly 100% attendance of members at the meetings, which was quite remarkable considering the fact that membership and attendance are voluntary. This shows a decided increase of interest over former years. The Chapter should have another banner year next year."

COLORADO STATE COLLEGE

The year at Colorado State College was devoted largely to the organization of the Student Chapter and to finding the best means of making it function properly.

Programs were presented by students and faculty. Some difficulty was experienced in obtaining outside speakers. The Chapter assumed entire responsibility for the civil engineering exhibits in connection with Engineers' Day.

The Chapter met with the University of Colorado Chapter and the Colorado Section of the Society at a dinner meeting in Denver in May.

The Local Section made its first Junior membership award to one of the members of the Colorado State Chapter.

UNIVERSITY OF COLORADO

The University of Colorado Student Chapter enjoyed another successful year of programs carefully prepared and well executed. There were several outside speakers of prominence and several inspection trips.

Four members of the Chapter attended the Spring Meeting of the Society at Kansas City. On invitation, delegates from the University of Wyoming and Colorado State College met at the University of Colorado on May 4, 1940, and organized the Rocky Mountain Conference of Student Chapters.

After an inspection trip in May in and near Denver, the University of Colorado Chapter and the Colorado State Chapter joined with the Colorado Section in a dinner meeting at which Junior membership awards were made. The annual dinner and Ketchum Award meeting, which closed the year's activities, was also held in May, and a member of the Chapter was announced as the winner of the Award and recipient of a Junior membership in the Society.

COLUMBIA UNIVERSITY

The meetings of the Columbia University Student Chapter, held weekly during the second semester, were devoted to presentation and discussion of student papers. These papers were prepared to constitute, when assembled and edited, a guide book and history of "The Bridges of New York."

COOPER UNION

The activities of the Cooper Union Chapter showed a considerable increase both in number and enthusiasm during the past school year. Two features in connection with these activities are especially worthy of note. During the year several programs featuring student speakers exclusively were developed. This constituted an innovation. Also faculty members appeared on some of the programs, and a greater interest on the part of the faculty than heretofore was evident.

CORNELL UNIVERSITY

This year's Chapter was handicapped by complete lack of previous records. Recognizing the value of such records for guidance, the Chapter has now established a file of records of the past year's activities, which will be available to future officers through the Faculty Adviser.

It has been recognized that in a college the size of Cornell there are many activities to attract the student. Accordingly the Chapter has tried to secure publicity for its meetings. The publicity included announcement of meeting by postcards, posters, notices in the university calendar, bulletin board, mimeographs, and blackboard notices, as well as announcement in the *Cornell Daily Sun*. The publicity job was given to the vice-president, but the spasmodic efforts of the publicity committee did not obtain the desired results. In this year's elections an attempt was made to remedy this by adding to the group of officers a chairman in charge of publicity. A bulletin board was obtained and maintained in the hall of the civil engineering school. Through the cooperation of the school, use of its mimeograph machine was obtained.

UNIVERSITY OF ILLINOIS

"The success of any organization depends upon the functioning of the various committees, and our Student Chapter is no exception. The committee chairmen and members have made this successful year possible by their continued enthusiasm and effort. The activities of the Chapter are planned by the Executive Committee, composed of the chairmen of standing committees, and the officers of the Chapter. Special committees are appointed for the larger events such as the annual smoker and banquet, while the standing committees on membership, program, publicity, and arrangements handle the regular and continuous work during the year."

DARTMOUTH COLLEGE (THAYER SCHOOL)

This year the Chapter assumed responsibility for the two-semester-hour seminar course, which is part of the curriculum of the Thayer School. At each weekly meeting (attendance and participation are compulsory) a forty-minute paper was presented by a student. This program proved very successful. At the graduation exercises a fifty-dollar prize was awarded by the Thayer Society of Engineers to the author of the best paper presented during the year.

UNIVERSITY OF DELAWARE

Chapter meetings are held once a month, and in spite of the handicap caused by the fact that many of the students are commuters the attendance has been very satisfactory. The meetings were in every case addressed by prominent engineers, who discussed various phases of engineering practice.

UNIVERSITY OF DETROIT

"The college of engineering at the University of Detroit is operated on a cooperative basis, and frequently—especially during the latter part of the second semester—it is difficult to set a date for meetings that will be agreeable to everyone. Consequently, the sharp drop in attendance noted for this period must not be misconstrued as a dwindling of interest in the Chapter's activities. We prefer to judge the interest of the members, and their appreciation of membership in the Society, by the fact that in this second year of our affiliation with the Society the membership in the Student Chapter comprised 96% of the total number of students enrolled in the university's course in civil engineering."

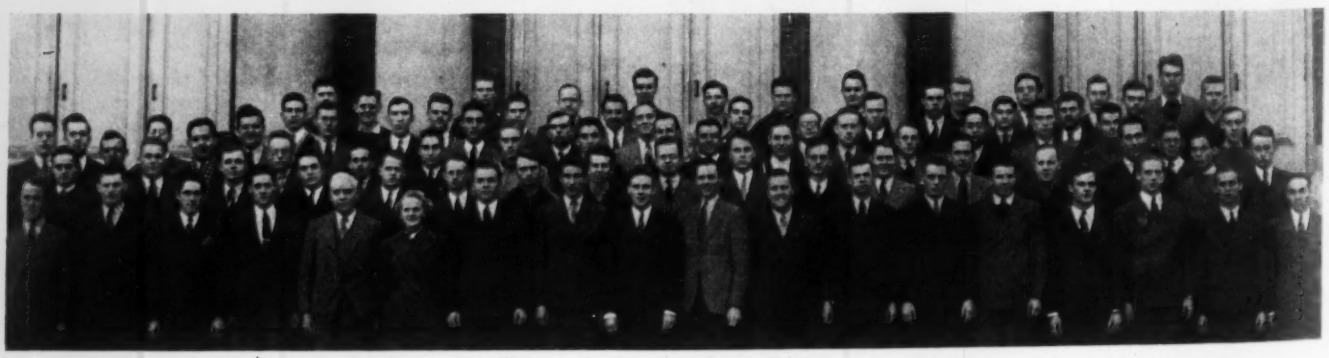
DUKE UNIVERSITY

The Duke University Student Chapter has just completed a very successful year. A large number of meetings were held, and the attendance at each was very satisfactory. The program committee provided opportunity for every member of the Chapter to present a technical talk at some meeting, and every member did make at least one speech. One particular meeting was set aside as "Sophomore Day," and at this session each sophomore member was allowed a maximum of ten minutes to describe some engineering project.

During the past year the Chapter has participated in two meetings of the Carolina Conference of Student Chapters. It was host to the conference last fall, and this spring a delegation of ten members of the Chapter was entertained by The Citadel, at Charleston, S.C.

GEORGE WASHINGTON UNIVERSITY

Careful attention was given to publicizing the activities of the Chapter. At the beginning of each semester letters were sent to all students registered in civil engineering. Bulletin board notices were carefully placed as early as possible before each meeting, and this was probably responsible for the large showing of guests.



THE UNIVERSITY OF ILLINOIS CHAPTER

STUDENT CHAPTER AT IOWA STATE COLLEGE

The weekly school paper not only carried notices of what was to come but also followed this up after the event by an account of what took place. This was intended to develop a spirit of unity among all who had shared in the events, and to make the "outsiders" desire to get in.

Excellent teamwork existed between the Chapter and the District of Columbia Section in regard to notices of meetings. The Local Section meeting would be announced at the Chapter meeting and the posting of the official announcement was instrumental in influencing the Chapter members to enjoy the hospitality of the Section.

UNIVERSITY OF FLORIDA

The University of Florida Chapter has functioned well during the past year, as clearly evidenced from the comprehensiveness of the programs shown in the annual report. The work was carefully outlined at the beginning of the year, when definite plans were made for a full year's work.

The esprit de corps of the members and attendance at meetings have always been and continue to be very high. The meetings

FOR THE ENGINEERS' FAIR AT THE UNIVERSITY OF FLORIDA
Student Chapter Members Put Finishing Touches on Model of Cloverleaf Highway Intersection

have been worth while, the programs excellent, and there has been enthusiastic discussion of all program material.

IOWA STATE COLLEGE

"In addition to the programs of a technical nature there were also a few mainly for the purpose of acquainting the students with each other and with the faculty. We believe this to be one of the most important phases of our activity. The programs were chosen to provide as much variety as possible. All talks are by outside engineers, since it has been the policy of the college to assist the students to acquire experience in certain fields in regular seminar courses instead of at Chapter meetings.

"The officers . . . compose a memorandum to be sent around to the faculty members before each Chapter meeting reminding them to make a good announcement about the coming event in their classes."

GEORGIA SCHOOL OF TECHNOLOGY

According to the annual report of the Chapter, the school year 1939–1940 has been an unusually successful one. The Chapter states that, under the guidance of the Faculty Adviser, it has attempted to do three things: (1) Stimulate interest in the profession by papers, talks, and inspection trips; (2) provide a means of social entertainment and "get togethers" through banquets, parties, and inspection trips; and (3) promote a close relationship between the students and the faculty by helping with projects of the department.

HARVARD UNIVERSITY

The Harvard University Student Chapter has completed its ninth year. Many interesting and well-known men have addressed the group, while field trips to neighboring plants and construction projects have produced a varied program.

Since the policy of the Chapter is to cooperate with other engineering societies at Harvard and at nearby schools, it has been possible to present more and varied programs than would have been possible for the Chapter acting alone. The Chapter invites all the students and their friends to its meetings whenever the subject is of general interest and not too technical.

UNIVERSITY OF IDAHO

A particularly successful year was enjoyed by the University of Idaho Student Chapter. Varied and interesting subjects were discussed, the Chapter was active on the campus, and relations with the Contact Member and the Spokane Section were excellent.

The Chapter joined with the Washington State College Chapter in two dinner meetings and was also represented at the Pacific Northwest Conference of Student Chapters, which was held at the University of Washington.

In its report, the Chapter pays tribute to the service and inspiration of its former Faculty Adviser, Prof. I. N. Carter, whose death occurred early in April.

UNIVERSITY OF KANSAS

At the request of its members the University of Kansas Chapter increased the number of its meetings from nine to fifteen. These included three special programs of interest to other departmental societies. A number of excellent outside speakers added variety to the program.

The Chapter served as host for the Regional Conference of Student Chapters, held in conjunction with the Society's meeting in Kansas City in April, and the demands incident to this responsibility did much to inspire members to greater activity. There have been many highly commendatory reports on the excellent manner in which the conference was handled. Directly after the close of

THE UNIVERSITY OF KANSAS STUDENT CHAPTER

the meetings in Kansas City, the Chapter turned its efforts to making the Engineering Exposition an outstanding success.

The report states that Prof. G. W. Bradshaw and Contact Member C. K. Mathews contributed materially to the successful outcome of the year's activities.

STATE UNIVERSITY OF IOWA

"Nine of the Society's illustrated lectures were given this year and proved to be quite popular. They were scattered throughout the year to provide variety in the programs.

"The 'Homecoming' activities in the fall and the Engineering Exhibit in the spring saw the Student Chapter members taking an active part. The Corn Monument for the Homecoming festivities was structurally designed and erected by the civil engineers. The Engineering Exhibit was held in May during the state music festival. Student Chapter members served as guides and experiment operators in the surveying department, materials laboratory, and hydraulics laboratory."

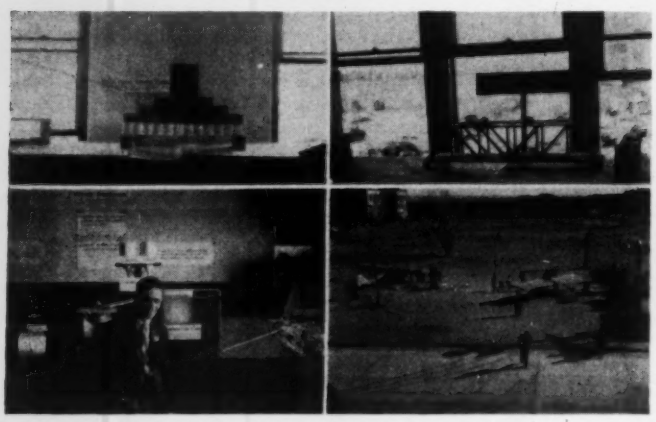
THE JOHNS HOPKINS UNIVERSITY

The members of the Chapter have enthusiastically approved of the year's activities, as evidenced by the unusually good attendance at the monthly meetings, particularly by the lower classmen. The annual report states, "We feel that we have had a clear understanding of the Society's motive in promoting Student Chapters—we hope that we have achieved these aims and ideals.

"The Chapter has once again followed the policy set forth by last year's administration. Many lecturers not of the engineering profession spoke so as to give their opinions on topics not included in our curriculum. However, in this regard, we went a step farther. The meetings were of such general interest to guests from other organizations that our facilities were severely taxed."

KANSAS STATE COLLEGE

The Kansas State College set-up is unique in that Student Chapter work is substituted for a curriculum requirement of departmental assemblies. This plan has been in force since the inauguration of the Chapter in 1923 and seems to meet with general approval. Students have an opportunity to participate in the meetings and to hear speakers of prominence. Attendance is required, but there is no hard and fast rule that students must be present at every meeting.



ENGINEERS' OPEN HOUSE AT KANSAS STATE COLLEGE

Outstanding events during the year were a senior inspection trip to Chicago and its vicinity; an engineers' open house, the theme of which was "The March of Civil Engineering"; and the attendance of 27 members at the Regional Student Chapter Conference held in conjunction with the Spring Meeting of the Society at Kansas City in April.

UNIVERSITY OF KENTUCKY

The University of Kentucky Chapter has 81 members and held 25 meetings during the year, with 12 papers presented by students. One of the high lights of the year was the annual inspection trip, held March 11 to 16, which covered many points of interest, including the Norris, Hiwassee, and Guntersville dams.

LEHIGH UNIVERSITY

Monthly meetings, each including a brief business meeting, a talk, and an open discussion, are the rule.

The Chapter states, "As in the past, our meetings were well attended and the speakers varied and interesting. It was our plan to present men from different fields of civil engineering—that is, from the fields of hydraulics, structures, highways, and railroads, and sanitary engineering. We hope to have an additional speaker next year and more student papers."

LEWIS INSTITUTE

"During the winter months we found it difficult to make field trips, and therefore substituted the Society's illustrated lectures. At these meetings we alternated the students who read the prepared lecture so that each might in a small way do some public speaking."

LOUISIANA STATE UNIVERSITY

Regular meetings did not constitute all the activities of the Louisiana State University Student Chapter; field trips comprised an important part of the program. Two trips were made to inspect the erection of steel on the Mississippi River Bridge, and in January a large percentage of the membership went to New Orleans to attend a joint meeting with the Louisiana Engineering Society. This trip included an inspection of the foundation settlement of the New Orleans Charity Hospital and a study of the plans for correcting this condition.

UNIVERSITY OF LOUISVILLE

From the very beginning the Chapter has taken a prominent part in the activities of the Speed Scientific School, in which all engineering facilities of the University of Louisville are housed. Since its establishment it has sponsored many inspection trips to projects around Louisville and throughout the state.

The past year has seen the "Intrados," proud of its newly acquired membership in the Society, take even greater interest in engineeering activities. Probably its most important contribution to the university was the organization and establishment of a Spring Surveying Camp. The year now closing has seen considerable progress, but it is the hope of the Chapter that much more can be accomplished in the future.

MEMBERS OF THE UNIVERSITY OF LOUISVILLE CHAPTER VISIT OHIO RIVER BRIDGE UNDER CONSTRUCTION AT OWENSBORO, KY.

UNIVERSITY OF MAINE

Because of local conditions the University of Maine Student Chapter does not undertake social activities, but confines its attention to professional meetings that supplement the regular course of instruction.

MANHATTAN COLLEGE

This year the Manhattan College Chapter has held several interesting professional meetings, taken part in the activities of the Metropolitan Conference of Student Chapters, participated in intramural athletics, and held the first of what it is hoped will be a series of informal dances.

MARQUETTE UNIVERSITY

The Marquette University Chapter has had nine meetings, all of which were well attended. At eight of these sessions there were programs covering a broad range of topics. Following its usual practice, the Chapter sponsored a bowling party for its mid-winter meeting.

UNIVERSITY OF MICHIGAN

"In arranging programs, the Chapter was anxious to broaden the members' viewpoint and education by making use of the diversified talents close at hand in the University of Michigan. Strictly engineering subjects were not deemed necessary for the principal talks, and effort was made to secure speakers from the liberal arts college and from other sources. In order to go beyond the usual classroom teaching, various members of the faculty gave talks from their experiences."

UNIVERSITY OF MISSOURI

The University of Missouri Student Chapter has enjoyed one of the most successful years since its founding. In spite of an increase in dues, membership is greater than ever before. There has been active cooperation between the faculty, Faculty Adviser, Contact Member, Chapter officers, committees, and the student members. This year, in contrast to former years, almost 60% of the sophomores were members of the Student Chapter. This has been accomplished only through the unceasing effort of the Chapter officers, and an interesting educational and social program.

THE UNIVERSITY OF MISSOURI CHAPTER

The 10 meetings held during the year included seven regular meetings, one joint session with the St. Louis Section of the Society, one meeting in conjunction with the Spring Meeting of the Society at Kansas City, and one dinner meeting.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

"In spite of interesting trips and distinguished speakers, the outstanding event of the year was the thesis seminar. Ten-minute talks were presented by the seniors on the subject matter of their theses, followed by five-minute question periods. This type of meeting brings out the very best in student participation, for it affords the opportunity for a student to speak before a critical audience on a subject with which he is familiar. It also introduces him to the general scheme of operation of the technical Society meeting."

MICHIGAN COLLEGE OF MINING AND TECHNOLOGY

The Student Chapter at the Michigan College of Mining and Technology had eight meetings. Interesting talks on dredging, geological surveys, Boulder Dam, asphalt, and general engineering experiences were given at six of these sessions.

MICHIGAN STATE COLLEGE

"Most of our meetings with a speaker were conducted in an informal atmosphere. The talks ranged in length from forty-five minutes to an hour and a half. The meeting was then thrown open to discussion. This procedure seems to work very well. It gives the members an excellent opportunity to listen, usually to a very interesting talk, and then participate in a group discussion. We have had about seven such meetings in the past year.

"One of the most unusual features of the year was the contest established by Mr. Conrad, our Contact Member. Wishing to get help on how to be of more assistance to the Student Chapter, Mr. Conrad offered prizes for the best papers on the topic 'Duties of a Contact Member.' A number of papers were written by the students and judged by Professor Allen, our Faculty Adviser. Then Mr. Conrad awarded cash prizes to the writers of the best papers."

UNIVERSITY OF MINNESOTA

The University of Minnesota Student Chapter had 11 meetings with programs that maintained a good balance between the technical and the social. The average attendance was good, attesting to the excellence of the arrangements.

UNIVERSITY OF MISSISSIPPI

The University of Mississippi Student Chapter states that it had an interesting and educational year. There were 13 well-attended meetings, at which student interest was marked, and the Chapter hopes for a still better year for 1940–1941.

UNIVERSITY OF MARYLAND

One of the most important functions of the Chapter this year has been to weld together the civil engineers in the colleges of engineering. There has been a notable increase in esprit de corps among all engineers on the campus and especially among the "civils." While membership in the Society is voluntary, its roster is almost 100% of those eligible for membership.

Attendance at meetings has been better than usual, due chiefly to the selection of dates suitable to a greater number of members. Off-campus meetings in Baltimore seem to have a peculiar attraction for members. Day meetings, which are used for Chapter business, are kept short and are held immediately after the class period, thus enabling many to attend. The programs have consisted almost entirely of talks on engineering subjects, and all have been illustrated with slides or films. Many of the speakers were in government service and thus had authoritative illustrations. The meeting with members from the campus branches of the other professional societies, tried for the first time this year under civil engineering auspices, was a conspicuous success.

MISSOURI SCHOOL OF MINES AND METALLURGY

"The Missouri School of Mines Chapter wishes to express its appreciation to the several speakers we have had during the year, to the faculty for its guidance, and to the Kansas City, St. Louis, and Mid-Missouri Local Sections of the Society for their generous help and cooperation during an active, interesting, and profitable year."

MISSISSIPPI STATE COLLEGE

According to the annual report, the Mississippi State College Chapter enjoyed an exceptionally successful series of meetings during the past school year. Attendance was excellent, and the interest taken in the meetings and the activities of the Chapter was quite satisfactory.

At Mississippi State the attempt is made to have a program that will keep the members personally interested. This is done by having them take active parts in a large number of the meetings.

The entire program is occasionally turned over to a committee selected for this purpose. Since the success of such programs rests entirely on the members, they have a responsible position in the Chapter. The committee appointments are rotated so that all members who desire may participate.

By alternating student speakers with outside speakers, varied programs were achieved.

SOME MEMBERS OF THE NEW YORK UNIVERSITY CHAPTER

MONTANA STATE COLLEGE

The Montana State College Chapter held 28 meetings during the school year. Chapter membership and attendance are compulsory for juniors and seniors in civil engineering. One outside speaker and nine of the Society's illustrated lectures supplemented a program of student papers. Five seniors attended the three-day Pacific Northwest Conference of Student Chapters, which was held at the University of Washington in Seattle in April.

UNIVERSITY OF NEVADA

In spite of its small size the University of Nevada Student Chapter is active. The support of the Contact Member and of the Sacramento Section, especially in furnishing speakers, is a material factor in the Chapter's success. Monthly meetings with well-qualified speakers and several inspection trips during the year have maintained interest in the Chapter.

Sponsored by the Chapter, the Society's illustrated lecture on the San Francisco–Oakland Bay Bridge was presented at a meeting of the Associated Engineers of the University of Nevada.

UNIVERSITY OF NEW HAMPSHIRE

Approximately half the meetings were occupied with the presentation of technical papers by students, and with the business of the Chapter. At the remaining meetings invited engineers gave talks on various phases of engineering practice, faculty members of other departments addressed the Chapter, and two meetings were devoted to the presentation of moving pictures of engineering work.

UNIVERSITY OF NEBRASKA

In spite of local conditions that interfered with Chapter activities, the University of Nebraska Chapter functioned well during the past year. Assigning each senior civil engineering student to some nearby member of the Society, who made it his business to become acquainted with the student, constituted an interesting innovation.

The Nebraska Chapter was well represented at the Student Chapter Conference in Kansas City. This conference was high in inspirational values and has created renewed interest in the Nebraska Chapter.

Prof. C. E. Michey's Award of a copy of the *American Civil Engineer's Handbook* to the student who had shown the greatest improvement went to John W. Cramer.

NEW YORK UNIVERSITY

Both the Day Group and the Evening Group began their year's work very early—the Day Group while the members were still in surveying camp in June 1939 and the Evening Group with a business meeting in August. The New York University Chapter has made a practice of inviting the members of other nearby Chapters, one or two at a time, to attend its Chapter meetings. These joint gatherings afford excellent opportunities for the making of mutual acquaintances and the exchanging of experiences and ideas. This year for the first time the Chapter sponsored social activities, the first of these occasions being a well-attended dance.

NEW MEXICO STATE COLLEGE

The New Mexico State College (D. B. Jett) Chapter was somewhat less active than in previous years. Not being located on a route of main travel, the Chapter has difficulty in obtaining prominent engineers as speakers. Although the Society's illustrated lectures were used extensively, there is a definite need for outside speakers.

Outstanding events of the year were an inspection trip and joint meeting with the University of Arizona Student Chapter, a joint meeting with the New Mexico Section and the University of New Mexico Student Chapter at Las Cruces, and attendance at the Highway Engineering Conference, which was held at the University of New Mexico. A contribution of $35 from the New Mexico Section aided materially in financing these trips.

THE COLLEGE OF THE CITY OF NEW YORK

This Chapter, with 27 meetings and several social events, has had a very active year. Talks given at the meetings, chiefly by practicing engineers, have covered a wide variety of subjects. Two sets of officers are elected—one for each semester.

NORTH CAROLINA STATE COLLEGE

The Chapter began the year with a membership drive. The first two meetings were planned to familiarize non-members with the importance of the Student Chapter and to point out the advantages offered by the Society to its members. At an informal smoker, Professor Johnson presented a brief history of the Society and pointed out that activity in the Chapter and in the Society develops qualities of leadership and brings the members into closer contact with other civil engineers.

NEWARK COLLEGE OF ENGINEERING

During the year the Chapter held nine interesting and well-attended technical meetings, which were addressed on a variety of topics by practicing engineers. In addition, the members of the Chapter took an active part in the college "At Home Day," and in the sessions of the Metropolitan Conference of Student Chapters. The year wound up with a flourish at a picnic, with faculty and students joining in games and in disposing of the "eats."

THE STUDENT CHAPTER AT NEWARK COLLEGE OF ENGINEERING

MEMBERS OF THE OREGON STATE COLLEGE STUDENT CHAPTER

NORTHEASTERN UNIVERSITY

The Northeastern University Student Chapter began its existence on March 15, 1940, at an installation banquet, which was attended by over a hundred students, faculty members, and practicing engineers from all over New England. From this auspicious beginning the Chapter carried forward a brief but interesting program for the rest of the year and is looking forward with keen anticipation to an active year in 1940-1941.

NORTHWESTERN UNIVERSITY

The Northwestern Student Chapter had an interesting and well-rounded program. The Chapter meetings were well attended, and the program was augmented by field trips to the Chicago subway and filtration plant.

NORWICH UNIVERSITY

The Norwich University Student Chapter has held varied meetings, the programs including addresses by students, faculty, and practicing engineers, the Society's illustrated lectures, and motion pictures.

OHIO NORTHERN UNIVERSITY

"These pages do not fully portray the spirit and cooperation shown by the members of our Chapter. Not only the officers but each and every member contributed his services and cooperation with a willingness which is rarely achieved in an organization of this type.

"Our President, Robert Ash, was so efficient at his duties in our Chapter that he was chosen chairman of the engineers' executive committee which controls the social functions and Engineers' Week in the engineering college.

"Our Chapter rallied behind an able leader to become the most outstanding engineering organization upon the campus.

"Throughout the year our aim has been to teach the engineering student his place in society and then help him to achieve that place by equipping him with the ability to sell himself and his project."

OREGON STATE COLLEGE

Through monthly technical meetings, two Sunday breakfast meetings, organized field trips, a picnic, a joint meeting with the Oregon Section, and activity in all-school functions, the Oregon State College Student Chapter presented a well-rounded program of technical, professional, and social development.

Attendance at the Pacific Northwest Student Chapter Conference at Seattle and Tacoma, Wash., in April was augmented by a contribution of $25 to help defray travel expenses from each of the four Pacific Northwest Sections. The Oregon Section also contributed $75 and the Student Chapter $20 to the civil engineering loan fund.

Other outstanding functions were the "Engineers' Bust" and the engineers' dance.

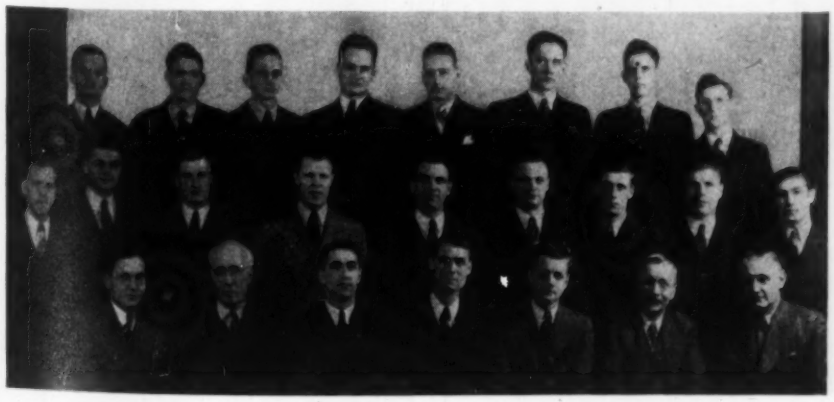
OHIO STATE UNIVERSITY

"The *ASCE News* was a small newspaper published five times during the school year by Editor David Lindsay and his assistants—Harold Husted, George Dengo, Jim Pickens, and Ray Schmidt. The paper contained jokes, humorous stories about students and instructors, announcements, results of intramural athletics, cartoons, and editorials. The publication achieved 100 per cent circulation in the civil engineering department."

NORTH DAKOTA STATE COLLEGE

In spite of the fact that the North Dakota State Chapter started the school year with a small membership, new members were added later and the Chapter enjoyed a successful year. The high lights of the year were the Student Chapter Conference at Kansas City, a meeting with the Northwestern Section at the University of Minnesota in Minneapolis, a joint meeting with the University of North Dakota Student Chapter at Fargo, and two inspection trips.

Students, faculty, and outside speakers presented a variety of subjects at the regular meetings.



MEMBERS OF UNIVERSITY OF NORTH DAKOTA STUDENT CHAPTER

UNIVERSITY OF NORTH DAKOTA

According to the annual report, there has been an increase in productive work and interest in the University of North Dakota Student Chapter during the past year. In spite of such handicaps as the distance of the college from important engineering projects and difficulty in obtaining outside speakers, definite progress has been made in building up a sense of responsibility on the part of members and in maintaining an interest in the affairs of the Society.

Outstanding events of the year were an inspection trip, Engineers' Day, the Spring Meeting of the Society and Student Chapter Conference at Kansas City, and a joint dinner meeting with the North Dakota State College Chapter.

UNIVERSITY OF OKLAHOMA

The University of Oklahoma Student Chapter functioned well during the year. The officers and members were alert in promoting Chapter affairs. Two joint meetings with the Student Chapter at the Oklahoma Agricultural and Mechanical College and the Oklahoma Local Section and a meeting with the officers of the Society were stimulating and helpful in developing a broad professional attitude.

OKLAHOMA AGRICULTURAL AND MECHANICAL COLLEGE

The Chapter had an active and successful year. The Chapter functions freely without too much faculty direction, and emphasis is placed on student accomplishment.

A high light of the year was a joint meeting with the University of Oklahoma Student Chapter and the Oklahoma Local Section at Stillwater. Dean Gibb Gilchrist came from the Agricultural and Mechanical College of Texas to address this meeting. Another joint meeting took place at Norman, the seat of the University of Oklahoma. The Chapter was well represented at the Student Chapter Conference held at the time of the Kansas City Meeting in April.

RHODE ISLAND STATE COLLEGE

As a separate organization the Rhode Island State College Student Chapter has conducted a varied program of interesting meetings, and through membership in the Rhode Island Engineers' Council has taken part in sponsoring a dinner, a dance, a smoker, and the publication of a magazine.

UNIVERSITY OF PENNSYLVANIA

With increased interest this year in Chapter and Society affairs, the members of the University of Pennsylvania Chapter have not only been faithful in attendance at Chapter meetings, but have been present at several of the meetings of the Philadelphia Section of the Society and at Student Chapter conferences. The Chapter was fortunate in that the Society's illustrated lectures on the San Francisco–Oakland Bay Bridge and the Bonneville Dam could be presented by students who had visited these projects.

PENNSYLVANIA MILITARY COLLEGE

The members of the Chapter at Pennsylvania Military College have this year made full use of their opportunity to attend meetings of the Philadelphia Section of the Society. The juniors and seniors in the Chapter attended all the engineering meetings of importance that were held in Philadelphia.

PENNSYLVANIA STATE COLLEGE

"Again this year we observed the custom of concluding the Chapter's activities with a banquet in honor of the members who graduate in June.

"The Chapter takes considerable pride in the publication of a news sheet called *The Tripod* for each meeting. This is the eleventh consecutive year for this publication which is edited and published by a committee of the members and contains articles on engineering and news notes of interest to members."

PURDUE UNIVERSITY

"Being mainly an engineering school and also the largest engineering school in the country, the Student Chapter at Purdue University is in a situation not comparable to that of the majority of the other Chapters. Nearly all the students are engineers, and consequently there is a very extensive program of engineering lectures and meetings carried on by the university and the various other professional and honorary societies.

VIEW OF ROSS SUMMER SURVEYING CAMP REQUIRED OF ALL "CIVILS" AT PURDUE

All Camp Facilities Are Built by Students to Gain Practical Experience

"For this reason the program sponsored by the Student Chapter should, and does, cooperate and not compete with the program sponsored by the university and other groups. As a result the Student Chapter here has fewer meetings than other Chapters and conducts ten meetings of a strictly civil engineering nature instead of 20 or more meetings of a more general nature."

RENSSELAER POLYTECHNIC INSTITUTE

The Chapter held three joint meetings during the year. These were with the student branch of the American Society of Mechanical Engineers, the American Institute of Architects, and the Mohawk-Hudson Section of the Society, respectively. These meetings were very successful, and it is planned to hold more of them in the future.

THE RICE INSTITUTE

In spite of rigid scholastic and unusual requirements for prescribed work, which leaves little time for extra-curricular activities, the Rice Institute Chapter has functioned well during the year.

A delegation of students attended the Spring Meeting of the Texas Section at Galveston, at which time the Rice Chapter was

MEMBERS AND GUESTS OF THE PENN STATE CHAPTER AT ANNUAL BANQUET HELD IN MAY

admitted to membership in the Texas Conference of Student Chapters. Several inspection trips were taken during the year, and the Chapter aided materially in the success of the Eleventh Biennial Rice Engineering Show.

As a result of the interest of prominent Houston engineers who are members of the Society, there has been a marked revival of interest in the Rice Institute Chapter.

Rose Polytechnic Institute

"The November meeting was high-lighted by a paper entitled 'History of Bridges,' presented by Bob Morse, a member of the Chapter. It was a most interesting talk, and when the speaker concluded his paper, both students and faculty members entered into an enjoyable round-table discussion concerning bridges. Mr. Morse's paper was considered meritorious enough to be published in the February issue of the school journal, *The Rose Technic*."

Rutgers University

Most of the Chapter meetings were addressed by practicing engineers. In addition, the Chapter took part with the student branches of the American Society of Mechanical Engineers and the American Institute of Electrical Engineers in two joint meetings and in social affairs.

University of Santa Clara

The University of Santa Clara Chapter enjoyed a successful year. As a result of the proximity of the university to San Francisco, junior and senior students take advantage of a standing invitation to attend the regular meetings of the San Francisco Section.

Clemson Agricultural and Mechanical College of South Carolina

"A majority of Chapter members took the trip to Durham, N.C., to attend the annual fall meeting of the Carolina Student Conference. Upon arrival at Duke we were introduced to our hosts and fellow Chapter members and then shown around the Duke campus. That night we were honored by a blanket bid to a pan-Hellenic dance.

"The following morning after the business meeting student papers were presented. During the afternoon we witnessed the Duke-Wake Forest football game. Following the game there was a banquet, at which the winners of the papers were announced. Duke took first place, Clemson second, and North Carolina State College third in the contest.

"The Chapter also took a trip to The Citadel at Charleston to attend the annual spring meeting of the Carolina Student Conference. On the way to Charleston we made an inspection trip to the Santee-Cooper Dam site. During the visit to the dam, several of our members applied for jobs, and since then several positions have been offered them."

University of South Carolina

The Chapter at the University of South Carolina held an average of two meetings each month from October through May. The 18 meetings attracted a total attendance of 317. Some of these sessions were devoted entirely to business and to preparation for field trips or other activities. The more interesting meetings included the showing of slides. Slide lectures on the Catskill water supply and the George Washington Bridge were furnished by the Society. An interesting field trip was made to the Santee-Cooper Project, and the Chapter sent nine members to the Carolina Chapter Conference at The Citadel in April 1940.

An analysis of attendance figures indicates that attendance has not been what it could have been. Part of this is due to the fact that a few of the members work at night and therefore cannot attend any of the regular night meetings. They do take part in other activities. Nevertheless, the annual report states that this has been a successful year for the Chapter.

South Dakota State College

The Society's slides and accompanying lecture on the Boulder Dam provided one of the Chapter's two most interesting meetings. The other outstanding session was the meeting of April 5, which was addressed by Walter E. Jessup, Field Secretary of the Society.

Six members of the Chapter and two faculty members attended the Spring Meeting of the Society and the Conference of Student Chapters at Kansas City. This Chapter received the travel award donated by the Kansas City Section to the Chapter whose representatives traveled the greatest distance to the conference.

South Dakota State School of Mines

In spite of limited means, a comparatively small enrolment, and the handicap of being located in a more or less isolated region, the Student Chapter at the South Dakota State School of Mines enjoyed an active year. The Society's illustrated lectures were used extensively.

The visit of Field Secretary Jessup was a high light of the year. More visits by Society members are desired. Great travel distances preclude extensive inspection trips, but one or two short trips are made each year.

Southern Methodist University

The Southern Methodist University Student Chapter was installed on March 1, 1940, with 23 student members and 41 members of the Dallas Branch of the Texas Section present. Principal speakers were Walter Meier, of the Atlantic Refining Company, and Prof. John A. Focht, secretary of the Texas Section. The forerunner of the new Student Chapter was the Civil Engineering Society, which maintained high standards on the Southern Methodist University campus. There has been a general desire on the part of every member of the old Civil Engineering Society to inspire all civil engineering students to become members of the new Student Chapter.

Left, Faculty Adviser Thompson of Southern Methodist University Chapter with Prof. H. J. Davis

Ten student members and three faculty members attended the Texas Conference of Student Chapters which was held in conjunction with the spring meeting of the Texas Section at Galveston. At this time the Southern Methodist University Student Chapter was elected a member of the Texas Conference of Student Chapters, and its president, Tom Crist, won first prize ($25 cash award given by the Texas Section) for his paper.

Swarthmore College

At six of the Chapter meetings senior students were the speakers. The remainder of the meetings were addressed by practicing engineers. The seniors attended three meetings of the Philadelphia Section. That greater interest is being shown in the publications of the Society is evidenced by the fact that seven of the members of the Chapter are regular subscribers to Civil Engineering.

Syracuse University

The Syracuse University Student Chapter had several interesting meetings. One outstanding event was a dinner for the faculty of the civil engineering department, its purpose being to make the students in the various classes better acquainted with each other. Each student was asked to state why he chose civil engineering as a profession. It is planned to make the dinner an annual affair.

University of Tennessee

The many interesting and educational programs of the University of Tennessee Chapter during the year just closed have been designed to give the student engineer a broader perspective and a deeper insight into his chosen profession. The officers of the Chapter have been alert to recognize the importance of keeping up undergraduate interest in the profession and in the Society. Speakers for the meetings have included students, faculty, outstanding engineers of this area, and members of the Society.

The Chapter considers that the year accomplished much in furtherance of the aims of the Society and in stimulation of the interest of all civil engineering students.

THE CHAPTER AT TEXAS A. & M. COLLEGE

TEXAS AGRICULTURAL AND MECHANICAL COLLEGE

The Texas Agricultural and Mechanical College Student Chapter reports another successful year, with further progress in developing and holding interest in the Chapter and Society affairs. Technical meetings with stimulating outside speakers were held regularly, and a dance, one of the outstanding social affairs of the college year, was sponsored by the Chapter. There has been increased student participation in the Chapter's programs.

The Chapter was well represented at both the fall and spring meetings of the Section. It also sent eleven delegates to the Mid-Continent Conference, which was held in conjunction with the Kansas City Meeting of the Society in April.

The Chapter, in sponsoring the civil engineering department "Open House," which is held in connection with Engineers' Day, contributed outstandingly to the success of this affair.

STANFORD UNIVERSITY

The activities of the Stanford University Student Chapter consisted of a well-balanced program of business meetings, social meetings, inspection trips, and attendance at the San Francisco Section meetings. Social meetings were held at the homes of faculty members, and speakers at these meetings were all non-faculty. Inspection trips included the Palo Alto underpass and the Hoover War and Peace Library, as well as a number of more distant projects, such as Shasta Dam. The Chapter was well represented at a number of the San Francisco Section meetings, and members derived much benefit therefrom.

The civil engineering scholarship, originated by Prof. C. B. Wing, former executive head of the department of civil engineering, was awarded to Carleton Yoder. The basis of this award is need, high scholarship, and intellectual and personal qualities presaging success in the profession.

UNIVERSITY OF TEXAS

The University of Texas Student Chapter has sponsored educational, social, and recreational activities, which indicate a broadening of interests on the part of its members. There is marked cooperation on the part of practicing engineers in promoting this program.

The Chapter was well represented at the fall and spring meetings of the Texas Section. Social activities included an open house in the fall for prospective members, a Christmas party for the civil engineering staff, and a Student Chapter picnic in the spring. The Chapter participated actively in the university's engineering banquet and engineers' dance, and was in charge of the civil engineering exhibits at the Power Show. All senior civil engineers had positions at the close of the school year.

TEXAS TECHNOLOGICAL COLLEGE

Early in the fall the Texas Technological College Student Chapter held a smoker for prospective members, and regular monthly meetings were held thereafter. Papers by students and the Society's illustrated lectures constituted most of the formal program.

The Chapter was represented at both the fall and spring meetings of the Texas Section and assumed responsibility for an inspection trip and for the civil engineering exhibits displayed at the college's Annual Engineering Show.

TUFTS COLLEGE

This year the Tufts College Student Chapter gave special attention to the planning and conduct of several inspection trips. The students had complete charge of "Engineering Night" at Tufts, and the Chapter assumed its full share of responsibility for this event.

TULANE UNIVERSITY

"The Tulane University Chapter has been wide awake and active, has continued to prove a factor of value in the lives of our students, and has been a decided asset to the civil engineering department.

"No university credit is allowed for the work of the Chapter, and the student knows that, to graduate, he must meet exacting requirements; nevertheless, the members have devoted so much time to the affairs of the Chapter that each year it has been increasingly effective.

"The Louisiana Section has been of material assistance to the Chapter and to its members. It was the first organization to establish a scholarship in the school of civil engineering; it donates a prize to be awarded to the outstanding member of the graduating class in civil engineering; and last year it founded an employment bureau which has aided the members of the student groups of the state in securing positions. The Tulane Student Chapter recognizes with deep appreciation that this Section has student welfare constantly in view.

"Throughout the entire six years of the Chapter's existence, its members have constantly endeavored by cooperative effort to ad-

GROUP FROM TULANE UNIVERSITY CHAPTER VISITS POWER PLANT AT WILSON DAM

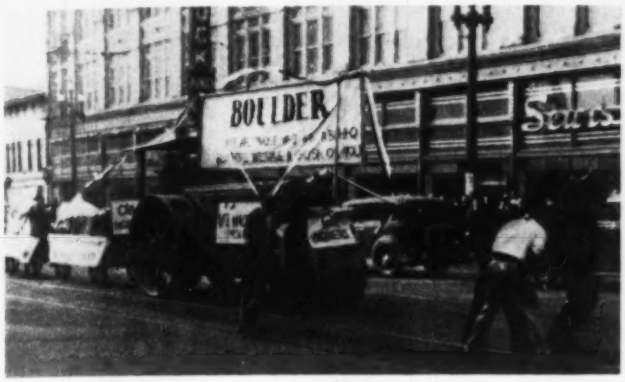
vance the objectives for which it was founded. We believe that there is developing in the Chapter an understanding of the value of professional contacts and a consciousness of the meaning of the word 'profession' as applied to engineering. By a balanced program of talks and technical papers given by both students and graduate engineers and by field trips it is felt that a considerable measure of success has been obtained."

UNION COLLEGE

During the year the Union College Student Chapter held five meetings, at three of which there were interesting talks on personnel work, the Sacandaga Reservoir, and city government. The Chapter keeps in close contact with the Mohawk-Hudson Section of the Society, and many members attend its meetings and activities.

UNIVERSITY OF UTAH

The University of Utah Student Chapter experienced an outstandingly successful year. Membership increased from 15 to 98, and the Chapter dominated campus activities in that it won two cups and a plaque in competition with the entire school. The



THE UNIVERSITY OF UTAH CHAPTER WON FIRST PRIZE WITH THIS FLOAT IN ANNUAL HOMECOMING PARADE

Chapter has maintained splendid interest and excellent attendance at meetings. It also participated in a joint meeting of all Society members at Logan, and in turn served as host to the Utah Section, the Junior Forum of the Utah Section, and the Utah State Agricultural College Student Chapter. The Chapter was instrumental in making the "Engineering Open House" better than ever.

UTAH STATE AGRICULTURAL COLLEGE

On account of its out-of-the-way location and distance from engineering centers, the Student Chapter at Utah State Agricultural College is largely on its own. The Chapter has made a particular effort to establish closer contact with the University of Utah Student Chapter and with the Utah Section of the Society.

On May 3 the Chapter sponsored a meeting of all Society members in the state. The attendance was 126. Later in the same month 21 seniors made a 13-day inspection trip to the major engineering projects in the Northwest.

VANDERBILT UNIVERSITY

The student body in the school of engineering at Vanderbilt University is relatively small, and the country-wide general decline in enrolment in civil engineering courses has been felt. However, students eligible for membership have joined the Chapter and have evinced keen interest in its affairs. At the regular meetings most of the papers were given by members of the Chapter.

Other meetings have been held with the student branches of the other engineering organizations on the campus, and a few joint meetings have been held with the Nashville Section of the Society. These joint meetings have proved mutually beneficial, and it is hoped that the Nashville Section will continue to foster them. Twice during the year the Chapter joins with all of the other student engineering organizations to conduct a general smoker for all engineers on the campus and their friends and alumni.

UNIVERSITY OF VERMONT

The University of Vermont Student Chapter conducted several interesting technical meetings and inspection trips, and sponsored a very successful open meeting which was addressed by a prominent speaker and attended by a large number of students, faculty, and guests.

UNIVERSITY OF VIRGINIA

The Chapter roll at the University of Virginia showed a membership of about 20 students. Meetings were held fairly regularly every three weeks throughout the year except for interruptions caused by examinations and holidays. A regular program of student papers was carried out, and prizes were awarded for the best papers in several contests. The papers presented at these contests, in order to receive consideration, had to be written and delivered before the Chapter, and judging was based about equally on the excellence of delivery and the content of the paper.

In the spring a number of Chapter members made an inspection trip to the plant of the Newport News Shipbuilding and Drydock Company.

UNIVERSITY OF WASHINGTON

The University of Washington Student Chapter had a varied program, including a series of lectures by students, faculty, and practicing engineers, field trips, engineering "open house" exhibits, banquets, athletic events, a picnic, and the bringing to fruition of the Pacific Northwest Conference of Student Chapters.

The Student Chapter satisfied a growing demand in the Pacific Northwest to provide an opportunity for students at various institutes to become acquainted, to exchange ideas, to compare

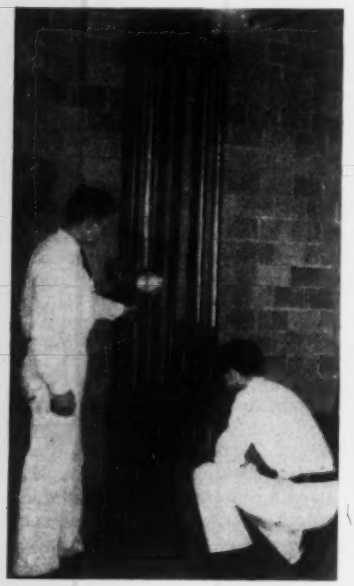
MEMBERS OF THE UNIVERSITY OF WASHINGTON STUDENT CHAPTER

courses, and to broaden their education. Great credit is due the Chapter, its officers, and Faculty Adviser for the effort that was involved in bringing together representatives from four far-flung Western states for a three-day series of inspection trips and meetings.

Members of the Chapter were active in campus affairs. Norman Dahl was an outstanding president of the Associated Students of the University of Washington, and Neil Haig has been elected to fill this position during the year 1940–1941.

VIRGINIA MILITARY INSTITUTE

During the past school year the Student Chapter at the Virginia Military Institute witnessed the completion of one of the most varied and extensive programs in the history of the Chapter. Starting promptly on September 16 with the organization meeting at which new officers were elected, the Chapter quickly got under way and maintained a busy schedule of activities throughout the year. A list of scheduled Chapter meetings was issued by the floor committee and this was closely adhered to. These regular meetings were interspersed with lectures by visiting specialists in different branches of the profession.



MEMBERS OF V. M. I. CHAPTER TEST COMPRESSIVE STRENGTH OF A COLUMN

The Chapter was also represented at the Annual Meeting in New York, the Spring Meeting in Kansas City, and at Virginia Section meetings in Richmond and Charlottesville. In this way a definite effort was made to familiarize the students with different aspects of the profession and to bring the purpose and functions of the Society closer to the individual.

VIRGINIA POLYTECHNIC INSTITUTE

There were 13 well-attended meetings during the year. The members of the Chapter are active and interested. Fifteen members attended the meeting of the Virginia Section at Roanoke, and representatives were sent to the Annual Meeting in New York. A smoker was held in April.

WASHINGTON STATE COLLEGE

Although the programs of the Washington State College Chapter are usually technical in nature, the past year's program was quite diversified. Talks by students, faculty, outside speakers, and the use of several excellent motion picture films provided a well-rounded program.

The Chapter had two joint meetings with the University of Idaho Student Chapter, participated in the Pacific Northwest Conference of Student Chapters, and joined in meetings with the Spokane Section at Spokane and at Grand Coulee Dam.

WASHINGTON UNIVERSITY

The Washington University Chapter held eight meetings during the year. The attendance of the students was excellent; and 92% of those eligible are members. A high light of the year was the annual dinner with the St. Louis Section.

WEST VIRGINIA UNIVERSITY

"The election of Charles Robinson as president during the first meeting of the new term was the spark that started the Student Chapter moving in the right direction. Under his leadership the Chapter drew up a program for the year which laid particular stress on developing interest in the Chapter through the methods which the Society itself employs—namely, by conventions, meetings, and conferences where noted speakers are heard and topics of importance are discussed. Inspection trips were also arranged.

"At the conclusion of our regular weekly meetings it is felt by all that we have accomplished that which we set out to do. We have given our members experience in preparing and presenting papers on technical and timely subjects. The quality of the papers has improved through the year due mainly to experience and the benefits derived from attending so many conventions. At these conventions valuable contacts were made with men high up in the profession which we are setting out to follow. These contacts are invaluable because they help to initiate us into the profession."

UNIVERSITY OF WISCONSIN

In carrying out the year's activities, it proved difficult to arrange programs that would hold the interest of all groups. A serious technical discussion does not appeal to the under classmen because they do not have the background necessary to understand and enjoy it. Thus it seemed advisable to have various types of programs. One of the Society's illustrated lectures received favorable comment as did some of the private movies. In spite of these attempts, however, the membership and interest of the lower classmen were not up to the standard of that of the advanced students.

WORCESTER POLYTECHNIC INSTITUTE

In addition to conducting a series of interesting and profitable local meetings, the Chapter at Worcester Polytechnic Institute was this year's host to the New England Student Chapter Conference.

UNIVERSITY OF WYOMING

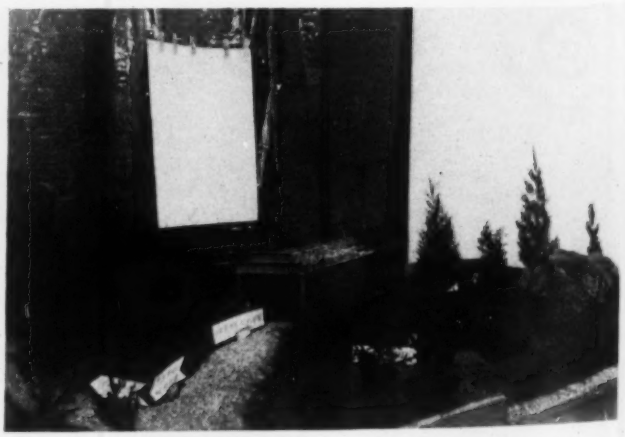
All eligible seniors, juniors, and sophomores in civil engineering at the University of Wyoming were members of the Student Chapter. Chapter programs were diversified, being presented by students, faculty, and practicing engineers. Two of the Society's illustrated lectures were also used.

The Chapter held two joint meetings with the Wyoming Section and participated in the organization of the Rocky Mountain Conference of Student Chapters at the University of Colorado on May 4, 1940. The Chapter will serve as host for the 1941 meeting of the Conference.

A number of awards and prizes are made to members of the Wyoming Chapter. Wayne W. Smith was the recipient of the university president's "Honor Book" award for high scholarship. The Swenson Award, which consists of a certificate and $50 and is given to the senior doing the best work in the courses in structural engineering, was won by Mark Henderson. The Chapter's award for the best student paper also went to Mark Henderson.

YALE UNIVERSITY

The Chapter has carried on a series of varied activities—professional, technical, and social. The three meetings which were addressed by guest speakers were made open meetings, and were well attended by members of the other departments as well as by those of the civil engineering department. A Yale civil engineering exhibit was this year sponsored and conducted by the Student Chapter.



MODEL OF LATTICE TRUSS DISPLAYED BY YALE CHAPTER AT ANNUAL ENGINEERING EXHIBIT

ITEMS OF INTEREST

Official and Semi-Official

CIVIL ENGINEERING for December

KEEPING up to date on changing materials and techniques in any specialized field sometimes seems a practical impossibility, but Maurice Housecroft's survey of developments in western bridge engineering is the kind of summary that helps. Illustrated with specific examples of loadings, steels, concretes, and designs, the presentation shows that highway bridge progress is holding to solid ground.

Both solid ground and soft ground are discussed by Trent R. Dames in an article on shear tests for foundation design. Field tests accumulated for several years have confirmed a very practical and simple correlation between permissible bearing values and laboratory tests of core samples. The use of core samples may be the answer to the foundation engineer's prayer for a method of getting at the weak spots not shown up by the more cumbersome field-loading test.

Interest in Gavin Hadden's treatment of the Colgate athletic fields will not be confined to ex-football sluggers who remember the mud battles of pre-drainage days. In addition to describing the complications of water removal from football and baseball fields, he presents problems of orientation, layout, and services.

Outlet works for large dams, with particular reference to the Grand Coulee Dam, are discussed by J. E. Warnock from the viewpoint of the design quirks revealed in the hydraulic laboratory, and the techniques of model study. Strange things can happen when 225,000 cu ft per sec must be released through sixty 8-ft holes in a 350-ft stone wall. Massive steel gate leaves even float on occasion, and where supercritical flow meets supercritical flow at the spillway surface, the resulting furor necessitates concrete intervention.

The cadastral surveys of the General Land Office, the curious details of an old covered bridge, construction practice in mixing and placing concrete on large dams, and the relation of engineers to the law are among the other subjects tentatively scheduled for the December issue.

Officers Distinguished by Promotion to Rank of General

INCLUDED among officers recently honored by promotion to high rank are five members of the Society. Edmund L. Daley, in command of the Puerto Rican Department at San Juan, has been advanced from brigadier general to major general. Raised from colonel to brigadier general are John C. H. Lee, division engineer for the North Pacific Division at Portland, Ore.; Francis B. Wilby, chief of staff of the 1st Army, Governors Island, N.Y.; Glen E. Edgerton, new governor of the Panama Canal Zone; and Eugene Reybold, assistant chief of staff, G-4, Washington, D.C.

Brief Notes

SOMEWHAT belatedly the Society has learned of the award of honorary degrees during the past commencement season to three members—S. O. Harper, K. B. Keener, and Frank A. Banks—who are connected with the U.S. Bureau of Reclamation. Mr. Harper, chief engineer for the Bureau, received the honorary degree of doctor of science from the University of Colorado; Mr. Keener, who is in charge of the division of dams, was awarded the honorary degree of doctor of science by Ohio Wesleyan University; and Mr. Banks, construction engineer for the Bureau at Grand Coulee Dam, received the honorary degree of doctor of engineering from the University of Maine. Other members of the Society thus honored were listed in the July, August, and September issues of CIVIL ENGINEERING.

* * * *

A NUMBER of interesting technical sessions have been scheduled for the twentieth annual meeting of the Highway Research Board of the National Research Council, which will be held December 4–6, 1940, in the building of the National Academy of Sciences, Washington, D.C.

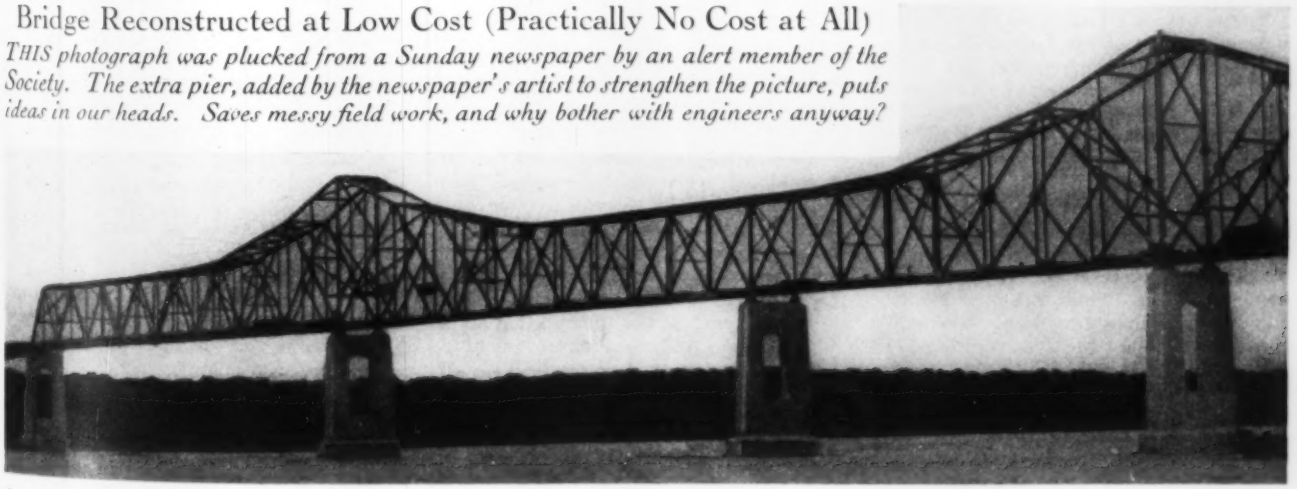
Civil Service Examination Announced and Dates Extended

MANY professional and sub-professional engineering examinations have been announced by the U.S. Civil Service Commission, and the Commission has departed from its usual practice by greatly extending the closing dates previously advertised. The examinations currently open and of special interest to civil engineers include:

TITLE AND OPTIONS	GRADES AND SALARIES	
Closing December 31, 1940		
Engineering Aid:		
(Topographic)	Senior	$2,000
(Aeronautical)	Chief	2,600
	Principal	2,300
	Senior	2,000
	(Aid)	1,800
	Assistant	1,620
Until further notice		
Engineering Draftsman:		
(Work on Ships)	Chief	2,600
	Principal	2,300
	Senior	2,000
	(Draftsman)	1,800
	Assistant	1,620
Closing June 30, 1941		
Engineer:		
(Electrical, heating and ventilating, materials, mechanical, mining, radio, structural, telegraph, telephone, welding)	Senior	4,600
	(Engineer)	3,800
	Associate	3,200
	Assistant	2,600
Civil Engineer:		
(Cadastral, construction, soil mechanics, safety, sanitary, general)	Senior	4,600
	(Engineer)	3,800
	Associate	3,200
	Assistant	2,600

Bridge Reconstructed at Low Cost (Practically No Cost at All)

THIS photograph was plucked from a Sunday newspaper by an alert member of the Society. The extra pier, added by the newspaper's artist to strengthen the picture, puts ideas in our heads. Saves messy field work, and why bother with engineers anyway?



Courtesy *The Delta Democrat—Times*

Prof. N. G. Neare's Column

Conducted by

R. ROBINSON ROWE, M. AM. SOC. C.E.

THOSE OF US who had witnessed the successful dunks of Ken Bridgewater's Dunking Bridge knew the answer to last month's problem before Professor Neare rose to his feet at the succeeding meeting of the Engineers Club. For it was history now that the test dunk at low tide had satisfied the guarantee by a margin of nearly one-half second. Also, that a stunt photographer, who had hidden under the draw-span deck for a scoop picture, found he had hooked a ride in the wrong direction; he barely succeeded in crawling out—with an Australian crawl.

"By elementary kinetics," said the Professor, "many of you computed the drawing speed in air to be 1.1 ft per sec, but not so many deduced correctly the distances to be run at extremes of tide. Obviously, if vessels require a clearance of 20 ft at mean tide, the same is required at flood or ebb. So the only running distance to vary with tidal stage is the run in air before dunking begins. At flood, the drawing time must have been 60 sec less the time for running 5 ft in air—at net time of 55.45 sec. Similarly, at ebb, the draw was made in the passable 64.55 sec.

"There are several entertaining problems arising from this epoch-making bridge which can wait, but to-nite our good friend Trautwine says he has a problem to propound. I'd rather solve riddles than contrive them, so I yield to John."

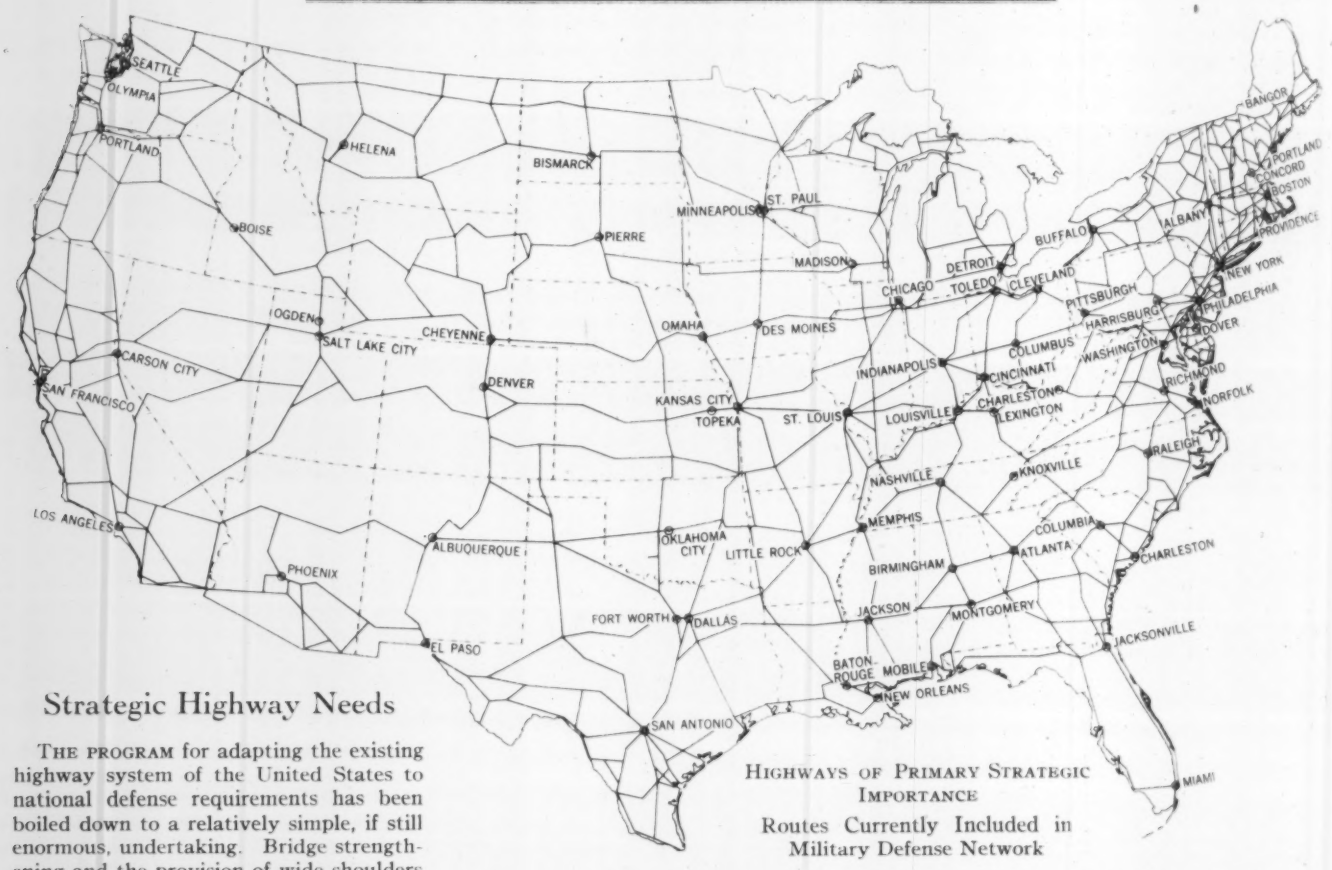
"And I'll only keep the floor a minute," said Mr. Trautwine. "The problem isn't mine, but that of my guest from Cuba. Allow me to introduce Chester Torrance as Guest Professor."

"Nor do I claim the problem as mine, except by adoption," said our Guest Professor. "As Truman Allen gave it to me in 1888 and I have never seen it in print, it may be novel to this generation. No pencils, please, as it must be solved by mental arithmetic.

"Visualize, if you please, a square field enclosed by a tight-board fence of 11-ft boards laid horizontally 4 boards high. Knowing that the number of boards in the fence equals the number of acres in the field, what is the size of the field? If any of you have solved it with a square field, I suggest you try it with a circular or hexagonal field."

"Thank you, Mr. Guest Professor, and I presume we may take a month for the solution so long as we are on our honor to do it mentally. I see one bright Junior with his hand up already, but I confess I'll need quiet concentration."

(Names of characters used in this column are not always fictitious, nor resemblance necessarily accidental. Messrs. Trautwine and Torrance are in fact John C. Trautwine 3d, M. Am. Soc. C.E., and Chester Torrance, Esq., who submitted this problem last February. Our respectful thanks.)



HIGHWAYS OF PRIMARY STRATEGIC IMPORTANCE

Routes Currently Included in Military Defense Network

Strategic Highway Needs

THE PROGRAM for adapting the existing highway system of the United States to national defense requirements has been boiled down to a relatively simple, if still enormous, undertaking. Bridge strengthening and the provision of wide shoulders for convoy parking are the measures considered most urgent. Of new construction, about 4,000 miles in a total system of nearly 75,000 are considered immediately important.

According to the Hon. Wilburn Cartwright and the Public Roads Administration, the routes now under investigation follow closely the system originally included on what is known as the "Pershing Map" of 1922—the first highway plan prepared by military authorities for defense purposes. With few exceptions, the roads indicated now, as then, are those most used in normal peace-time life.

The loading currently considered acceptable for bridges is the standard H-15. Bridges designed for this will accommodate all classes of military equipment, except tanks, without special traffic control. The heaviest tanks, 50-ton, can be carried if they are spaced at 50 ft and limited to four miles per hour. It is estimated that about 1,800 bridges will need improvement to meet this requirement.

All road surfaces on the strategic system should be dustless and capable of supporting 9,000-lb wheel loads under any weather condition. All surfaces less than 18 ft in width should be widened immediately to at least 20 ft and to 22 or 24 ft where a particularly large volume of traffic is expected.

Experience in connection with the army maneuvers has demonstrated that shoulders 8 or 10 ft wide to permit parking of trains of vehicles are particularly essential where both civil and military traffic must be provided for. In many sections of the country, continuous shoulders of this width would be difficult to construct. The minimum requirement therefore tentatively agreed upon is a parking shoulder 2,000 ft long at least every four miles for traffic in each direction. Such parking

lanes should be so staggered on opposite sides of the road that one occurs about every two miles.

New mileage is associated primarily with the various military and naval reservations, bases, and landing fields, and with newly located defense industries. To meet the construction and maintenance needs in the several categories, funds are available from previously appropriated but not obligated federal-aid money, currently appropriated federal-aid money, and possibly allotments from the Works Progress Administration.

NEWS OF ENGINEERS

Personal Items About Society Members

VERNE GONGWER has accepted a position as chief engineer of the Department of Public Utilities of Tacoma, Wash. Mr. Gongwer had previously been with the city of Tacoma, but more recently was project engineer for the Tennessee Valley Authority on the construction of Guntersville Dam.

HARRY B. HENDERLITE, for the past several years state highway engineer of Louisiana, has been designated chief engineer and head of the entire engineering division of the Louisiana Department of Highways, which has been reorganized from the State Highway Department. N. E. LANT, former bridge engineer, will head the bridge design subdivision.

A. A. G. KIRCHHOFF, captain, Corps of Engineers, U.S. Army, has been ordered to duty with troops and assigned to the 19th Engineers (combat) stationed at Monterey, Calif. He was formerly head of the administrative section in the District Engineer's office at Los Angeles.

S. F. YASINES has resigned as assistant professor of civil engineering at New York University in order to accept a position as aeronautical engineer in stress analysis and design with the Edo Aircraft Corporation at College Point, N.Y.

ELMER K. TIMBY was recently promoted from the position of assistant professor of civil engineering at Princeton University to that of associate professor.

EUGENE LIPPA is now employed as an engineer with the Bechtel-McCone-Parsons Corporation, engineering and contracting organization with headquarters in Los Angeles.

B. P. RICE, until lately sanitary engineer for the South Carolina State Board of Health, has become supervising engineer of the Bond Service Division of the Reconstruction Finance Corporation. He is located in Atlanta, Ga.

THOMAS H. EVANS has been promoted from the position of assistant professor of civil engineering at the University of Virginia to that of associate professor.

HAMILTON GRAY, for the past four years with Moran, Proctor, Freeman, and Mueser, New York City engineers, has been appointed by New York University to establish and direct a new laboratory for the study of foundation soils and soil mechanics.

ROBERT M. LINGO has accepted a position as instructor in civil engineering at the University of Maryland.

RUSSELL C. BRINKER has been granted a year's leave of absence from the University of Hawaii, where he is assistant professor of engineering, to serve as assistant professor of civil engineering at the University of Minnesota.

WILLIAM H. CARPER has resigned as city engineer of Fredericksburg, Va., in order to become town manager of Culpeper.

ROBERT L. MACDOUGALL, of Atlanta, Ga., was recently appointed assistant to the U.S. Housing Coordinator in Washington, D.C.

VERNE L. PEUGH is now chief engineer for the Winston Brothers Company, with headquarters in Minneapolis, Minn.

JOHN H. MELVIN has resigned from the U.S. Engineer Department, for which he was resident geologist at Norfolk Dam in northern Arkansas, to accept a position with the Pennsylvania Drilling Company, in Pittsburgh, Pa.

T. J. STRICKLER, since 1927 vice-president and general manager of the Kansas City Gas Company, Kansas City, Mo., was elected president of the American Gas Association at the twenty-second annual convention of that organization, held in

T. J. STRICKLER

Atlantic City, N.J., on October 8. Long prominent in public utility engineering, Mr. Strickler has been a director of the Association for a number of years and has also served as vice-president.

A. GEORGE MALLIS, who is a lieutenant in Company K of the 28th Infantry, was recently transferred from Fort Ontario at Oswego, N.Y., to Fort Jackson at Columbia, S.C.

OSWALD SPEIR, hydraulic engineer, has been transferred from the U.S. Engineer Office at Sacramento to the office of the Division Engineer, South Pacific Division, with headquarters in San Francisco.

HOWARD F. PECKWORTH has been promoted from the position of resident engineer inspector for the PWA at Pinopolis Dam, S.C., to that of senior engineer for the PWA.

ERNEST ARTHUR ROLISON, formerly county executive of San Mateo County, California, is now budget examiner in the Bureau of the Budget, Washington, D.C.

WILLIAM RICHARD WALLIS has resigned as a structural engineer for the New Mexico State Highway Department in order to accept a position with Allied Engineers, Los Angeles (Calif.) consulting firm.

PAUL J. CANNELL is now chief of the structural steel section of the Panama Canal Commission and is located at Diablo Heights, C.Z. He was previously hydraulic engineer and chief designer for the Central Nebraska Public Power and Irrigation District, with headquarters at Hastings, Nebr.

GERALD M. RIDENOUR recently accepted a position as associate professor of sanitary engineering at Pennsylvania State College. Formerly he was associate in water and sewage research at the New Jersey Agricultural Experiment Station and, also, assistant professor of water supply and sewage disposal at Rutgers University.

JONATHAN G. WRIGHT is now in the employ of A. W. Earl, consulting engineer of San Francisco.

HAROLD F. GRAY, sanitary and hydraulic engineer of Berkeley, Calif., has been elected president of the California Sewage Works Association.

BRUCE D. GREENSHIELDS, for the past three years associate professor of civil engineering at the College of the City of New York, has been appointed adjunct professor of civil engineering at the Polytechnic Institute of Brooklyn.

D. GRANT MICKLE was recently appointed traffic engineer for Detroit, Mich. Mr. Mickle has been serving as state traffic and safety engineer.

HOMER A. HUNTER has been named assistant city engineer of Dallas, Tex. Mr. Hunter was formerly secretary and executive director of the Fort Worth (Tex.) Housing Authority.

ROBERT H. DODDS recently resigned as editorial assistant in the New York office of *Engineering News-Record* in order to do postgraduate work in journalism at Northwestern University during the coming year.

PAUL P. RICE has been promoted from the position of instructor in civil engineering at Lafayette College to that of assistant professor of civil engineering.

W. D. DOCKERY is now special research engineer for the Texas State Highway Department, with headquarters at Austin, Tex. He was previously assistant state highway engineer for field service in the Department.

DANA YOUNG, associate professor of civil engineering at the University of Connecticut, has been appointed head of the civil engineering department.

DONALD C. HILTON is now in the Antarctic, where he is serving as a member of the Byrd expedition.

DECEASED

CHARLES DREWRY BATSON (Assoc. M. '11) manager of the Republic Creosoting Company, Mobile, Ala., died on May 7, 1940, though word of his death has just reached the Society. Mr. Batson, who was 56, was for some time assistant engineer in charge of the water works department of the city of St. Paul, Minn. Over twenty years ago he went to Mobile to become manager of the Republic Creosoting Company.

CLAUD FRANCIS BLAIN (Assoc. M. '22) supervising engineer of Victoria, Australia, died there on February 14, 1940, though word of his death has just reached Society Headquarters. Mr. Blain, who was 67, was a native of Australia and had spent his entire career there—in private practice at Rockhampton and Perth from 1897 to 1908, and successively as locating and supervising engineer for the Public Works Department of Sydney from 1909 to 1936.

GEORGE GOODELL EARL (M. '94) since 1931 consulting engineer and chief engineer of the Earl Engineering Company, New Orleans, La , died there on September 16, 1940. He was 76. From 1892 to 1899 Mr. Earl was chief engineer of the New Orleans Sewerage Company, and from 1900 to 1931, consulting engineer of the New Orleans Water Works Company and general superintendent and chief engineer of the Sewerage and Water Board of New Orleans. He was a former president and honorary member of the American Water Works Association.

JOHN CLAIR FOWLER (Assoc. M. '18) chief field engineer for the City of Spokane, Wash., died there on August 20, 1940. Mr. Fowler, who was 62, had lived in Spokane for over thirty years. He was for many years superintendent of the City Asphalt Department of Spokane, and in 1938 he became chief field engineer for the city.

WILLIAM RICHARD GELSTON (Assoc. M. '16) for thirty-three years superintendent of the Quincy (Ill.) Water Works Commission, was fatally injured in an automobile accident on September 27, 1940. Mr. Gelston, who was 72, was a recognized authority on water-works management and engineering. Before going to Quincy in 1907, he had for some time been with the Chicago, Burlington, and Quincy Railroad.

JAMES HENRY HAYLOW (M. '11) of Memphis, Tenn., died on August 28, 1940, at the age of 70. Mr. Haylow was chief engineer of the Memphis Street Railway Company from 1906 until his retirement in 1939. Earlier in his career he was with the Cleveland Board of Park Commissioners (1894 to 1899), the Jones and Laughlin Steel Company, and Ford, Bacon and Davis, representing the latter organization in Birmingham and Nashville.

CARL SWING HERITAGE (M.'26) bridge engineer for the Kansas City Southern Railway, Kansas City, Mo., died there on August 31, 1940. Mr. Heritage, who was 60, had been in the bridge department of the railroad since 1910. He was a former president of the American Railway Bridge Building Association.

ROBERT LEROY JONES (M. '27) deputy state engineer of California, Sacramento, Calif., died at his home there on September 12, 1940, at the age of 53. Mr. Jones was chief engineer of the Sutter Basin Company, Sacramento, from 1917 to 1921; associate engineer in the California Department of Public Works, 1921 to 1923; and assistant engineer for the California State Reclamation Board, 1923 to 1927. In the latter year he became principal hydraulic engineer and deputy state engineer in the Department of Public Works.

FREDERICK HUMPHREVILLE LEWIS (M. '97) of Charlottesville, Va., died there on August 31, 1940, at the age of 82. Mr. Lewis was prominent in the cement industry and had supervised the erection of cement plants for the Portland Cement Company throughout the country. He had also maintained consulting offices in Charlottesville and Birmingham, Ala.

LEONOR FRESNEL LOREE (M. '86) who retired in 1938 as president of the Delaware and Hudson, died at his home at West Orange, N.J., on September 6, 1940. He was 82. Long regarded as one of the important figures in American railroading, Mr. Loree entered railroad work in 1877 as an engineering assistant with the Pennsylvania Railroad. He served as president of the Baltimore and Ohio and of the Kansas City Southern and in high executive posts with the Chicago, Rock Island and Pacific Railway and the St. Louis–San Francisco Railway before going to the Delaware and Hudson.

FRED ELMER MURPHY (Assoc. M. '12) for the past six months city service director of Knoxville, Tenn., died at his home there recently at the age of 61. Before the war Mr. Murphy was vice-president and chief engineer for the C. W. Hunt Company of West New Brighton, N.Y., in which capacity he designed coaling stations for the U.S. Navy. During the war he served as captain in the ordnance department of the army. Later (1925 to 1930) he was with Stevens and Wood, of New York City and, before accepting his present appointment, served as engineer for the Knoxville Housing Authority.

EMORY DONALD OLSON (Jun. '37) junior engineer for the U.S. Bureau of Reclamation at Denver, Colo., died recently at the age of 25. Following his graduation from Iowa State College in 1936, Mr. Olson served for two years as an assistant in the civil engineering department at the University of Illinois. He then became connected with the U.S. Bureau of Reclamation.

CLIFFORD MORGAN PINCKNEY (M. '23) who retired last year as chief engineer of the Borough of Manhattan to become chief engineer of the West Side Association of Commerce of New York, died in New Rochelle, N.Y., on September 11, 1940. He was 57. Mr. Pinckney had been in the service of the city for thirty-four years and chief engineer of Manhattan for twenty years at the time of his retirement. He promoted many of the master improvement projects of the Borough, including the East River Drive and the Wards Island sewage treatment plant, and produced a plan for the relief of traffic congestion, which has been followed in many recent improvements.

JOSEPH RIPLEY (M. '01) of Albany, N.Y., died at his home in that city on September 28, 1940, at the age of 86. From 1877 to 1905 Mr. Ripley was engaged on the construction of public projects, including the St. Mary's Falls Ship Canal. In 1905 he was appointed a member of the consulting board of international engineers for the Panama Canal, and from 1907 to 1918 served as advisory engineer of the New York State Department of Public Works. He then went to China as chief engineer of the Grand Canal Improvement and, upon his return to this country, maintained a consulting practice in Albany.

ROY FRANCIS RUDOLPH (M. '31) associate engineer in the U.S. Engineer Office at Panama City, Fla., died on September 16, 1940. He was 54. From 1911 to 1917 Mr. Rudolph was with the Mississippi River Commission at Vicksburg, and from 1919 to 1926 with the Mississippi State Highway Commission. Later he was county engineer of Union County, Mississippi. During the war he served with the rank of captain in the Field Artillery of the U.S. Army.

WALTER WILLIAM SCHLECHT (M. '09) of Brooklyn, N.Y., died in that city on September 2, 1940, at the age of 63. From 1902 to 1921 Mr. Schlecht was assistant engineer to the Project Manager of the U.S. Reclamation Service; from 1921 to 1929 with contractors on the construction of dams and power plants in Brazil and Puerto Rico; and from 1930 to 1932 in charge of reports on the development of the rivers in Alabama for power, navigation, and flood control.

CHARLES VICTOR SEASTONE (M. '16) consulting engineer of Madison, Wis., died at his home there on September 26, 1940, at the age of 68. Mr. Seastone had been associated with Daniel W. Mead, Past-President and Honorary Member of the Society, for many years—from 1912 to 1933 as partner in the engineering firm of Mead and Seastone and since 1933 as consulting engineer for Mead, Ward, and Hunt. Before going to Madison in 1907 Mr. Seastone was for ten years a member of the engineering faculty at the University of Illinois.

The Society welcomes additional biographical material to supplement these brief notes and to be available for use in the official memoirs for "Transactions."

Changes in Membership Grades

Additions, Transfers, Reinstatements, and Resignations

From September 10 to October 9, 1940, Inclusive

Additions to Membership

ADAMS, JOHN ELVIN (Jun. '40), Cadet Engr., Washington Gas Light Co., 411 Tenth St., N.W. (Res., 1506 East Capitol St.), Washington, D.C.

ALTMAN, RICHARD (Assoc. M.'40), Cartographic Engr., U.S. Engr. Dept., 751 South Figueroa St., Los Angeles, Calif.

ARCHIBALD, THOMAS RICHIE (Assoc. M. '40), Constr. Engr., Board of Education, 13 South Fitzhugh St. (Res., 105 Albemarle Rd.), Rochester, N.Y.

ASPLUND, GEORGE ALLEN (Jun. '40), Box 951, Enid, Okla.

BAILEY, GEORGE WILLIAM, JR. (Jun. '40), Civ. Engr., Petricca Constr. Co., West St. (Res., 338 South Appleton Ave.), Pittsfield, Mass.

BASZNER, RAYMOND WALSH (Jun. '40), Chf. Draftsman, Charles A. Maguire & Associates, 1515 Turks Head Bldg. (Res., 71 Pinehurst Ave.), Providence, R.I.

BEERUP, CLOYD DOUGLAS (Assoc. M. '40), Instr., Civ. Eng., Michigan State College, East Lansing, Mich.

BEJARANO, CARLOS ANTONIO (Jun. '40), 303 Livingston Hall, Columbia Univ., New York, N.Y.

BELCHER, DONALD JENKS (Jun. '40), Research Engr., Joint Highway Research Project, Purdue Univ. (Res., 243 Harrison St.), West Lafayette, Ind.

BLAISDELL, EDWIN NORTH (Jun. '40), Junior Architectural Engr., Ordnance Dept., U.S. Army, Raritan Arsenal, Metuchen, N.J. (Res., 6 Arden Pl., Yonkers, N.Y.)

BLYTHE, DAVID KNOX (Jun. '40), Georgetown, Ky.

BOESSNECK, WALTER OSCAR (Assoc. M. '40), Senior Draftsman, Erie R.R., 740 Midland Bldg., Cleveland (Res., 1603 Bunts Rd., Lakewood), Ohio.

BOYER, HENRY FRANK (Jun. '40), Junior Engr., U.S. Engr. Office, 1001 Chamber of Commerce Bldg., Pittsburgh, Pa.

BRANT, FREDERICK RUSSELL (M. '40), Supt., Public Buildings Administration, Federal Works Agency, Procurement Bldg., Washington, D.C. (Res., 418 Toll House Rd., Silver Spring, Md.)

BRESCIA, RALPH NICHOLAS (Jun. '40), Asst. Engr., Administrative Staff, Div. of Operations, Federal Works Agency, 70 Columbus Ave. (Res., 1741 Pilgrim Ave.), New York, N.Y.

BRIMBLE, GEORGE CLIFFORD (M. '40), 297 Thirteenth St., Oakland, Calif.

BYERS, EDWIN WILLIAM (M. '40), Vice-Pres., Newman Caisson Co., 23 North Aberdeen St. (Res., 1423 Hudson Ave.), Chicago, Ill.

CARPENTER, JOHN ERWIN, JR. (Jun. '40), Rodman, State Highway Dept., Paris, Tex.

CARR, JOSEPH ARTHUR (M. '40), Supt., Water Dept., 25 Hudson St. (Res., 111 Claremont Rd.), Ridgewood, N.J.

CONGDON, WILLIAM HOLMES (Assoc. M. '40), Asst. Engr., U.S. Indian Service, CCC-ID, 719 Security Bldg., Phoenix, Ariz.

COTTON, JOHN STERLING (M. '40), Senior Engr., Federal Power Comm., 300 Phelan Bldg., San Francisco, Calif.

COZZA, MICHAEL RICHARD (Assoc. M. '40), Senior Designing Engr., City of Pittsburgh, City-County Bldg. (Res., 2058 Lucina Ave.), Pittsburgh, Pa.

CRANE, RALPH AMZI (Jun. '40), Junior Engr., E. I. du Pont de Nemours & Co., Wilmington, Del. (Res., 27 South Main St., Woodstown, N.J.)

CRAWSHAW, ARTHUR CLYDE (Assoc. M. '40), Civ. Eng. Draftsman, Airport Dept., Public Utilities Comm., 425 Mason St., Room 502, San Francisco, Calif.

DAHANUKAR, SHANTARAM MAHADEO (Jun. '40), Care, M. L. Dahanukar & Co., Ltd., Industrial Assurance Bldg., Bombay, India.

DEBS, ROBERT WILLIAM (Jun. '40), Junior Civ. Engr., State Highway Dept., Box 98, Auburn (Res., 116 Oliver St., Greenville), Ala.

DIETZ, ALBERT GEORGE HENRY (Assoc. M. '40), Instr., Dept. of Building Eng. and Constr., Room 5-304, Mass. Inst. Tech., Cambridge, Mass.

DILLON, LEE SOMMERVILLE (M. '40), Lt.-Col., Corps of Engrs., U.S. Army, 39 Whitehall St., New York, N.Y.

DUBOIS, PAUL EMILE (Jun. '40), Asst. Engr., City Engr. Dept., 408 Municipal Bldg., Oklahoma City, Okla.

DYE, EDWARD RANDOLPH (M. '40), Associate Prof., Civ. Eng., Montana State College (Res., 1122 South 3d St.), Bozeman, Mont.

ELKINS, ROBERT EDWARD (Jun. '40), Care, Adams & Ruxton Const. Co., 1387 Main St., Springfield, Mass.

EUBANKS, CECIL EARL (Assoc. M. '40), Engr., Bureau of Water, Knoxville Elec. Power and Water Board, 626 South Gay St. (Res., 1320 East 5th Ave.), Knoxville, Tenn.

EVANS, GILES LINCOLN, JR. (Jun. '40), Lt., Corps of Engrs., U.S. Army, 41st Engrs., Fort Bragg, N.C.

FAGRE, STANLEY CHARLES (Jun. '40), Foreman, Fagre Contr. Co., 916 North 7th St., Estherville (Res., Hawarden), Iowa.

FISCHER, HENRY WALLACE (Jun. '40), 247 Mount Hope Blvd., Hastings-on-Hudson, N.Y.

FRIEDLANDER, ARNOLD (Jun. '40), Junior Engr., FCS 9, U.S. Bureau of Reclamation, Dept. of Interior, Dodge Apartments, Alma, Nebr.

GENTRY, JAMES ROY (Jun. '39), 225 High St., Chattanooga, Tenn.

GERARDY, MAURICE NORMAN (Assoc. M. '40), Associate Engr. (Hydraulics), Dept. of Water Supply, 805 Water Board Bldg., Detroit, Mich.

GILLETTE, GEORGE WILLIAM (M. '40), Lt.-Col., Corps of Engrs., U.S. Army, U.S. Engr. Office, Custom House, Wilmington, N.C.

GINGELL, HOWARD A. (Assoc. M. '40), Asst. Engr., Starrett Brothers & Eken, Inc., 40 Wall St., New York (Res., 4415 Forty-third Ave., Long Island City), N.Y.

GRAGNOLA, JOHN ROBERT (Assoc. M. '40), Eng. Insp., Dept. of Public Works, Municipal Bldg. (Res., 3745 Willett Ave.), New York, N.Y.

GRAHAM, STEPHEN EDMUND, JR. (Jun. '40), 615 Franklin St., Santa Clara, Calif.

GRIFFITHS, DAVID WOOD (M. '40), Maj., Corps of Engrs., U.S. Army, U.S. Engr. Office, Little Rock, Ark.

GROSS, JOSEPH WILLIAM (Assoc. M. '40), Secy., Wayne County Road Commrs., 3800 Barlum Tower, Detroit, Mich.

HALFF, ALBERT HENRY (Jun. '40), Instr., Texas Agri. and Industrial College, Kingsville, Tex.

HALL, WILLIAM HARVEY (Jun. '40), Box 115, Pawhuska, Okla.

HAMMOND, DAVID GREENE (Jun. '40), 1st Lt., Corps of Engrs., U.S. Army, 28th Engrs., Ketchikan, Alaska.

HARRINGTON, HORRALL (Jun. '40), Draftsman, Am. Bridge Co. (Res., 4 Glenwood), Ambridge, Pa.

TOTAL MEMBERSHIP AS OF OCTOBER 9, 1940	
Members	5,652
Associate Members	6,446
Corporate Members	12,098
Honorary Members	31
Juniors	4,095
Affiliates	70
Fellows	1
Total	16,295

HARRIS, FREDERICK ARTHUR (Jun. '40), Junior Engr., U.S. Waterways Experiment Station, Box 631, Vicksburg, Miss.

HASSON, HERBERT HESS (Assoc. M. '40), San. Engr., W. K. Kellogg Foundation, 258 Champion St., Battle Creek, Mich.

HAYES, CHARLES EDWARD (M' 40), Engr. in chg., Federal Aid Secondary Program, State Highway Dept., Lansing, Mich.

HAZEN, ALLEN (Jun. '40), Engr. Apprentice, P.R.R. (Res., 829 Park Ave., South), Erie, Pa.

HESELTON, FRANK RICHMOND (Jun. '40), Junior Engr., U.S. Engr. Office, 60 South Beaver St., York, Pa.

HIGGINS, JOSEPH MELCHIADES (Jun. '40), Care, Mason & Hanger Co., Inc., Dixie Hotel, Radford, Va.

HOAR, VICTOR MYERS (Assoc. M. '40), Asst. Engr., Federal Power Comm., 1757 K St., N.W., Washington, D.C. (Res., 104 Mary Lee Bldg., Beverly Plaza Gardens, Alexandria, Va.)

HOPKINS, GEORGE FREDERICK (Assoc. M. '40), Associate Engr., U.S. Engr. Dept., 700 Central Bldg., Seattle, Wash.

HUNT, HAROLD WINFRED (Assoc. M. '40), Asst. Editor, *Engineering News-Record*, McGraw-Hill Publishing Co., 330 West 42d St., New York (Res., 29-19 One hundred and seventy-first St., Flushing), N.Y.

JOHNSON, ARTHUR BRADFORD (Assoc. M. '40), Civ. Eng. Asst., Dept. of Water and Power, 207 South Broadway (Res., 647 Maltman Ave.), Los Angeles, Calif.

KEATING, LAMBERT DANIEL (Jun. '40), Rodman, C. M. St. P. & P. R.R., Marion, Iowa (Res., 4429 Congress St., Chicago, Ill.)

KERSTING, EDWARD HENRY (Assoc. M. '40), Sales Engr., Carnegie Illinois Steel Corp., 208 South La Salle St., Room 1608, Chicago, Ill.

KISDUCAK, FRANK STEVE (Jun. '40), With Naval Torpedo Station, Keyport, Wash.

KLINER, WALTER JOSEPH FRANK (Jun. '40), Draftsman, Crawford Co., 3220 West 31st St. (Res., 6211 South Keating Ave.), Chicago, Ill.

KULHAN, EDWARD FRANK (Jun. '40), Junior Eng. Aid, Dept. of Public Works, Div. of Highways (Res., 950 Roosevelt Ave.), Fresno, Calif.

KUSHING, JOHN WESLEY (Assoc. M. '40), Research Engr., State Highway Dept. (Res., 1007 Seymour Ave.), Lansing, Mich.

LACROIX, ARTHUR EDWARD (M. '40), 441 Stuart St., Boston, Mass.

LAFORCE, HARRY BERNHARD (Jun. '40), Asst. Building Mechanic, Illinois Bell Telephone Co., 212 West Washington St., Chicago, Ill. (Res. 301 Indiana Ave., Valparaiso, Ind.)

LANCASTER, DALE MARION (Jun. '40), Asst. Engr., U.S. Bureau of Reclamation, 406 Custom House, Denver, Colo.

LAURENT, LOUIS EMILE (M. '40), Asst. Engr., Erie R.R., 711 Midland Bldg., Cleveland, Ohio.

LAWSON, HEATHCOTE WILLIAM (M. '40), Engr., Fabricated Steel Constr., Bethlehem Steel Co. (Res., 243 East Church St.), Bethlehem, Pa.

LINDSTROM, ORVILLE RICHARD (Jun. '40), Rodman, State Highway Dept., 17th Ave. and Jackson (Res., 1802 East Portland St.), Phoenix, Ariz.

LORANCE, ROBERT NEAL (Jun. '40), 1021 Circle Park, Knoxville, Tenn.

MCGAVOCK, CECIL BILLUPS, JR. (Jun. '40), Asst. Geologist, TVA, 202 Pound Bldg. (Res., 2401 York St.), Chattanooga, Tenn.

MCLAREN, HUGH, JR. (Jun. '40), Timekeeper, Vermilya-Brown Co., Inc., 100 East 42d St., New York (Res., 11124 One hundred and ninety-seventh St., Hollis), N.Y.

MCWHORTER, GEORGE ELLSWORTH, JR. (Jun. '40), Instrumentman, State Highway Dept., Eatonton, Ga.

MARSHALL, ALFRED COOKMAN (M. '40), Pres. and Gen. Mgr., The Detroit Edison Co., 2000 Second Ave., Detroit, Mich.

MASSEY, THEO (Assoc. M. '40), Asst. Div. Engr., State Highway Dept., 930 Martin Bldg. (Res., 900 North 53d St.), Birmingham, Ala.

MATHIS, SAMUEL JACKSON (Jun. '40), Office Asst., State Highway Maintenance Engr., State Highway Dept., Senate St. (Res., 810 Bellwood Ave.), Columbia, S.C.

MORTON, GEORGE ARTHUR (Jun. '40), 803 Pound Bldg., Chattanooga, Tenn.

MYRICK, SAMUEL ALEXANDER (Jun. '40), Care, U.S. Engrs., Box 157, Booneville, Ark.

NOWAKOWSKI, EDWARD (Jun. '40), Junior Mech. Engr., TVA, Union Bldg., Knoxville, Tenn.

OLGLESBY, HENRY RUBE, JR. (Jun. '40), Engr., Carrothers & Crouch, 7419 Broadway, Kansas City, Mo.

PECK, GEORGE SHERMAN (Jun. '40), Rodman, C. B. & Q. R.R., 503 Jackson Blvd., Chicago (Res., 421 James St., Geneva), Ill.

PLOMTEAUX, CHARLES HENRY, JR. (Jun. '40), Junior Engr., Shell Chemical Co., Pittsburg (Res., 122 West Reed St., San Jose), Calif.

REILL, JAMES BERTRAND (Assoc. M. '40), Designer, Bethlehem Co., 701 East 3d St. (Res., 134 East Broad St.), Bethlehem, Pa.

RHOADES, CLIFFORD THOMAS (M. '40), Structural Engr., New England Public Service Co., Green St. (Res., 189 State St.), Augusta, Me.

RITTENHOUSE, TOM LOVELACE (Jun. '40), With State Highway Dept., Flagstaff (Res., Williams), Ariz.

RODRIGUEZ, FEDERICO DAVID ADAMS (Jun. '40), Rodman, State Highway Dept., 2300 Roosevelt Ave., San Antonio, Tex.

ROSE, ELLSWORTH LOUIS (Jun. '40), Designer, Cerro de Pasco Copper Corp., Cerro de Pasco, Peru.

SCHICK, ROBERT ALLEN (Jun. '40), Structural Detailer; Eng. Dept., Boeing Aircraft Co. (Res., 1723 Summit Ave.), Seattle, Wash.

SCHOLES, RICHARD THOMAS (M. '40), Asst. to Chf. Engr., C. B. & Q. R.R., 547 West Jackson Blvd., Chicago, Ill.

SCHRADER, HENRY CARL (Jun. '40), 3648 North Avers Ave., Chicago, Ill.

SCHULTEN, WILLIAM JOHN (M. '40), Engr. on Special Assignment, State Highway Dept., Jefferson City, Mo.

SCOFIELD, WALTER FLEMING (Jun. '40), Instr., The Rice Inst., Houston, Tex.

SEYFANG, WILLIAM GEORGE (M. '40), Managing Engr., Board of Education, City Hall (Res., 116 Dorchester Rd.), Buffalo, N.Y.

SHILLINGER, WILLIAM DANE (Jun. '40), Junior Engr., State Board of Health, 1098 West Michigan St., Indianapolis, Ind. (Res., 610 East Liberty St., Ann Arbor, Mich.)

SKINNER, RALPH DOUGLAS (Jun. '40), Civ. Engr., Henry B. McKoy Co., Finlay Bldg. (Res., 218 East Park Ave.), Greenville, S.C.

SMITH, VINCENT BASIL (Assoc. M. '40), Associate Editor, *Constr. Methods*, McGraw-Hill Publishing Co., 330 West 42d St., New York, N.Y.

SONESON, PHILLIP ERVIN (Assoc. M. '40), Asst. Prof., Architectural Eng., Purdue Univ., 311 Civil Bldg., West Lafayette, Ind.

STALFORT, HENRY ALFRED (Assoc. M. '40), Project Mgr., Consolidated Eng. Co., 20 East Franklin St. (Res., 224 Goodale Rd.), Baltimore, Md.

STEBBINS, WILLIAM ALFRED (Assoc. M. '40), Design Engr., Bridge Dept., State Highway Dept. (Res., 138 State St.), Montpelier, Vt.

STRAUS, HOWARD (Jun. '40), Instrumentman, Straus Constr. Co., 60 Park Pl. (Res., 51 Schuyler Ave.), Newark, N.J.

THOMPSON, CHARLES BENJAMIN (Jun. '40), Rodman, State Dept. of Roads and Irrig., Auburn, Nebr.

TRIPP, EDWARD (Assoc. M. '40), Asst. Hydr. Engr., U.S. Geological Survey, Ohio State Univ., Columbus, Ohio.

TRUE, WILLIAM HOWARD (Assoc. M. '40), Chf. Engr., Ludman Corp., 3427 North Miami Ave., Miami, Fla.

TRUJILLO, JOE ADOLPH (Jun. '40), 716 South 13th St., Albuquerque, N.Mex.

ULRICH, FRED WILLIAM (Jun. '40), Asst. Project Engr., State Highway Comm., Camden (Res., 121 Wood St., West Lafayette), Ind.

WAGNER, CHARLES HENRY (M. '40), Res. Engr., Corps of Engrs., U.S. Army, Confluence, Pa.

WEBBER, WARD PERRY (M. '40), Engr., National Park Service, 7415 Interior Bldg., Washington, D.C.

WELCH, JOHN FRANK, JR. (Jun. '40), Asst. Engr. Draftsman, TVA, 203 Pound Bldg. (Res., 721 Glenwood Drive), Chattanooga, Tenn.

WEST, JOHN RYLAND (Jun. '40), Surveyor, Office of Dallas County Surveyor, Court House (Res., 5621 Tremont St.), Dallas, Tex.

WHISLER, BENJAMIN ADSIT (Assoc. M. '40), Asst. Prof., Civ. Eng. Dept., Iowa State College, Ames, Iowa.

WHITE, FRANK PAUL (Assoc. M. '40), Dist. Planning Engr., WPA, Federal Works Agency, Bldg. 52, Wood, Wis.

WOLFF, JEROME BENJAMIN (Jun. '40), Structural Draftsman, U.S. Engr. Dept., 203 Calvert Bldg. (Res., 304 East University Parkway), Baltimore, Md.

WOOD, JACK RICHARD (Jun. '40), Insp., State Highway Comm., State House Annex, Indianapolis (Res., Farmersburg), Ind.

WOODBRIDGE, EDWIN WILSON (Assoc. M. '40), City Engr., 507 City Hall, Omaha, Nebr.

WOODHOUSE, GLENN ADELBERT (M. '40), Chf. Engr., Am. Water Works Constr. Co., 50 Broad St., New York, N.Y.

WOODSMALL, FRANCIS JOSEPH (Jun. '40), 200 South St., West Lafayette, Ind.

ZYNDA, STANLEY GEORGE (Jun. '40), 526 West Nittany Ave., State College, Pa.

MEMBERSHIP TRANSFERS

BARBEE, EDWIN WALLACE (Jun. '38; Assoc. M. '40), Water Purification Engr., San Francisco Water Dept. Laboratory, Millbrae, Calif.

BARBER, PHILIP ERNEST, JR. (Jun. '29; Assoc. M. '40), Office Engr., Humble Oil & Refining Co., Box 2180 (Res., 4130 Riley), Houston, Tex.

BOUCHARD, HARRY (Assoc. M. '29; M. '40), Associate Prof., Geodesy and Surveying, Univ. of Michigan (Res., 1111 Woodlawn Ave.), Ann Arbor, Mich.

BRETT, THOMAS BRONSON (Jun. '30; Assoc. M. '40), Associate Engr., U.S. Engr. Office, 925 New Federal Bldg., Pittsburgh, Pa.

BRINGHURST, JOHN HENRY, JR. (Jun. '34; Assoc. M. '40), Res. Engr., J. E. Sirrine & Co., Greenville, S.C.

BRINKMAN, HARRY WILLIAM (Jun. '30; Assoc. M. '40), Estimator, The Phoenix Bridge Co., Phoenixville, Pa.

BROWNE, HAROLD GEORGE (Jun. '32; Assoc. M. '40), Associate Engr., U.S. Engr. Dept., 751 South Figueroa St. (Res., 156 South Lucerne Blvd.), Los Angeles, Calif.

CHAMBERLIN, STEPHEN JOHNES (Jun. '28; Assoc. M. '40), Asst. Prof., Theoretical and Applied Mechanics, Room 103 Laboratory of Mechanics, Iowa State College, Ames, Iowa.

CLOSE, ROSS ARTHUR (Jun. '31; Assoc. M. '40), Civ. Engr., U.S. Engr. Office, War Dept., Box 119, Norfolk, Va.

DAVIS, PHILIP (Jun. '39; Assoc. M. '40), Junior Engr. (Civ.), U.S. Engr. Office, Mobile, Ala.

EBERLE, RUDOLPH EUGENE (Jun. '34; Assoc. M. '40), Res. Engr., Paulette & Wilson, Box 272, Bucklin, Kans.

FABER, SVEN ERIK (Assoc. M. '30; M. '40), Cons. Civ. Engr., 47 St. George's Bldg., Hongkong, Hongkong.

FUHRMAN, RALPH EDWARD (Jun. '30; Assoc. M. '40), Asst. Supt., Sewage Treatment Plant, District of Columbia, Blue Plains, Washington, D.C.

GALLOGLY, RALPH FRED (Jun. '29; Assoc. M. '40), Capt. (FA), Quartermaster Reserve, Office of Quartermaster General, Constr. Div., Administration Branch, Washington, D.C.

HARTMAN, PAUL (Jun. '33; Assoc. M. '40), Instr., Dept. of Civ. Eng., College of the City of New York, Amsterdam Ave. and 140th St. (Res., 2505 Aqueduct Ave., West), New York, N.Y.

HASSELBACH, WILLIAM HENRY (Jun. '27; Assoc. M. '36; M. '40), Chf. Constr. Engr., Libbey-Owens-Ford Glass Co., 1701 East Broadway (Res., 2516 Charlestown Ave.), Toledo, Ohio.

HODGES, THOMAS LAWRENCE (Jun. '32; Assoc. M. '40), Sales Engr., Am. Bitumuls Co., 1955 Chesapeake Ave., Baltimore, Md. (Res., 900 North Elm St., Greensboro, N.C.)

IPPEN, ARTHUR THOMAS (Jun. '35; Assoc. M. '40), Asst. Prof., Dept. of Civ. Eng., Lehigh Univ. (Res., 319 Washington Ave.), Bethlehem, Pa.

JACKSON, JAMES ALLEN (Jun. '37; Assoc. M. '40), San. Engr., State Board of Health, 1098 West Michigan (Res., 1440 Montcalm St.), Indianapolis, Ind.

JANSSEN, ALLEN SHEELEY (Jun. '33; Assoc. M. '40), Testing Engr., State Bureau of Highways; Asst. Prof., Civ. Eng., College of Eng., Univ. of Idaho, Box 301, University Station, Moscow, Idaho.

KENNEY, NORMAN DURLING (Assoc. M. '36; M. '40), Associate Engr., Whitman, Requardt & Smith, West Biddle St. at Charles, Baltimore, Md.

KISSAM, PHILIP (Assoc. M. '34; M. '40), Associate Prof., Civ. Eng., Princeton Univ. (Res., 15 Newlin Rd.), Princeton, N.J.

KRUSE, MARVIN OTTO (Jun. '33; Assoc. M. '40), Engr., Stanley Eng. Co., Central States Bank Bldg. (Res., 404 Broadway), Muscatine, Iowa.

LORD, ROY STANLEY (Jun. '30; Assoc. M. '40), Associate Hydr. Engr., U.S. Geological Survey, Water Resources Branch, Room 490 Education Bldg., Harrisburg, Pa.

MATTHEWS, CHARLES WILLIAM (Assoc. M. '36; M. '40), Res. Planning Engr., Ladislav Segoe, Tucson Regional Plan, 90 North Church St. (Res., 2522 East 3d St.), Tucson, Ariz.

NEES, LOUIS AUGUST (Jun. '31; Assoc. M. '40), Asst. Engr. (Hydr.), U.S. Engr. Dept., Federal Bldg., Cincinnati, Ohio.

NELIDOV, IVAN MANUELOVICH (Assoc. M. '27; M. '40), Senior Engr. of Hydr. Structure Design, Dept. of Public Works, State Div. of Water Resources, 12th and N St. (Res., Hotel Clunie), Sacramento, Calif.

NEWCOMB, NORMAN BEST (Jun. '31; Assoc. M. '40), Draftsman, Phelps Dodge Corp., 25 Broadway, New York, N.Y. (Res., 45 Leland Ave., Plainfield, N.J.)

NOLAND, THOMAS JEFFERSON, JR. (Jun. '31; Assoc. M. '40), Asst. Engr., U.S. Bureau of Reclamation, U.S. Custom House, Denver, Colo.

PATTERSON, WILLIAM DARYL (Jun. '21; Assoc. M. '27; M. '40), Hydrographic and Geodetic Engr., U.S. Coast and Geodetic Survey, Washington, D.C.

PIERCE, ALTON LOUIS (Jun. '34; Assoc. M. '40), Asst. Engr., U.S. Engr. Office, Southern Pacific Div., 1200 Balfour Bldg., San Francisco, Calif.

POSS, ROBERT JOSEPH (Jun. '31; Assoc. M. '40), Junior Engr., U.S. Engr. Office, 408 Federal Bldg., Milwaukee, Wis.

QUIRIN, EDWARD JOSEPH (Jun. '37; Assoc. M. '40), Chf. Draftsman, Frederic R. Harris, Inc., 27 William St., New York (Res., 105-47 Sixty-fifth Rd., Forest Hills), N.Y.

RALSTON, HARRY JAMES (Jun. '34; Assoc. M. '40), Asst. Engr., Elson T. Killam, 142 Maiden Lane, New York, N.Y. (Res., 4 Huyler Ave., Tenafly, N.J.)

SCHMIDT, GEORGE EDWARD (Jun. '32; Assoc. M. '40), Prin. Eng. Draftsman, TVA, 803 Pound Bldg. (Res., 1105 Concord St.), Chattanooga, Tenn.

SHAW, GEORGE REED (Jun. '37; Assoc. M. '40), Asst. Prof., Dept. of Road Eng. and Geodesy, Rensselaer Polytechnic Inst., Troy, N.Y.

STUART, CRUIKSHANK (Jun. '28; Assoc. M. '40), Asst. Constr. Engr., Bureau of Agri. Chemistry and Eng., U.S. Dept. of Agriculture, Box 22, East Lansing, Mich. (Res., 413 Bretton Pl., Baltimore, Md.)

STUBLER, ANDREW JAMES (Jun. '34; Assoc. M. '40), 3903 Wilkens Ave., Baltimore, Md.

TYRRELL, FRANK CHARLES (Jun. '28; Assoc. M. '40), Asst. to Design Mgr., Bureau of Yards and Docks, Navy Bldg., Washington, D.C. (Res., 1410 Patrick Henry Drive, Apt. 120, Arlington, Va.)

WAGNER, EDWARD PLATT (Jun. '35; Assoc. M. '40), Civ. and San. Engr., E. L. Wagner, 55 West 42d St., New York (Res., 31 Farrel St., New Hyde Park), N.Y.

WARDEN, ROY ELISHA (Assoc. M. '20; M. '40), Engr., Public Impvts.; Attorney, Mo. Pac. R.R., 319 Union Station, Little Rock, Ark.

WERNER, PER WILHELM (Assoc. M. '25; M. '40), Cons. Civ. Engr., A. B. Vattenbyggnadsbyran, Humlegardsgatan 29, Stockholm, Sweden.

WHINNERAH, RICHARD WALTER (Jun. '29; Assoc. M. '40), Associate Engr., Dept. of Interior, U.S. Bureau of Reclamation, 446 U.S. Custom House, Denver, Colo.

WHITE, MERIT PENNIMAN (Jun. '36; Assoc. M. '40), Asst. Prof., Illinois Inst. of Technology, 3300 Federal, Chicago, Ill.

WILSON, WARREN ELVIN (Jun. '32; Assoc. M. '40), Prof. and Head, Dept. of Mechanics, Colorado School of Mines, Golden, Colo.

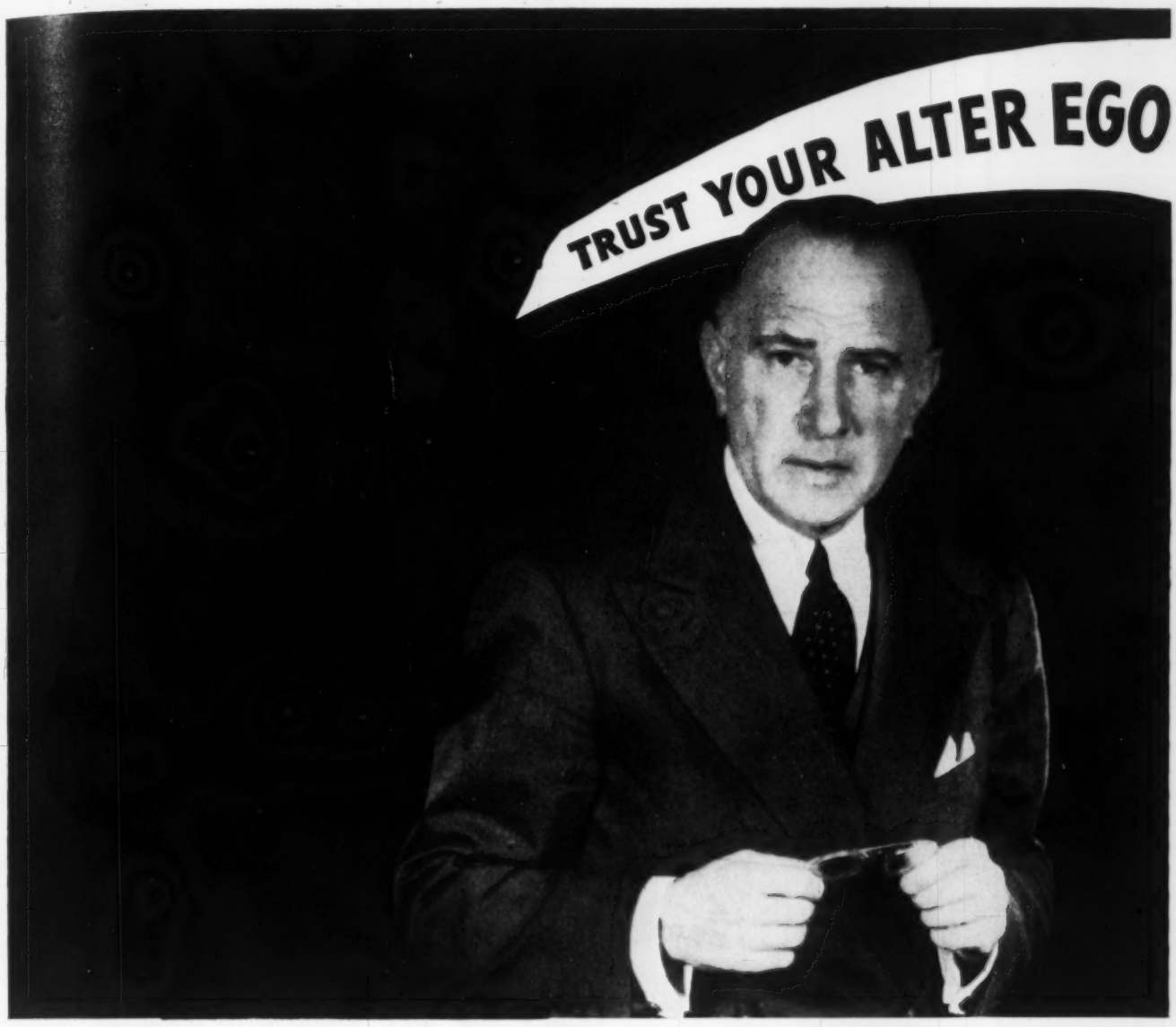
WOULFE FLANAGAN, JOHN HENRY (Assoc. M. '29; M. '39), 14F Hyde Park Mansions, London, N.W. 1, England.

REINSTATEMENTS

ANDERSON, ANDREW MATTHEW, Assoc. M., reinstated Sept. 16, 1940.

BURKE, WALTER ANTHONY, JR., Assoc. M., reinstated Sept. 27, 1940.

TRUST YOUR ALTER EGO



ALTER EGO: Literally "one's other self"—the still, small voice that questions, inspires and corrects our conscious action.

ALTER EGO: Let's talk things over. As your other self, I feel it my duty to give you some advice on how to improve your product and cut its cost.

Well, you're one fellow I don't mind getting advice from. I know you won't try to sell me something.

ALTER EGO: All right. Here's my suggestion. First, improve your reasoning technique. Learn to *trust your Alter Ego*. Listen to that inner voice more often.

All right, but I've had to use my conscious mind so much to ward off exposure to arc welding salesmen that I've got in the habit of trusting my surface judgment.

ALTER EGO: Yes, and because of surface reasoning you're too prone to deride that which you don't sufficiently understand. Look how others are profiting with arc welding.

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ALTER EGO: I understand that Lincoln is a good source for arc welding information that's devoid of your pet aversion. Not a high-pressure sales talk in a book-full.

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CLAWSON, EARL MONTGOMERY, Assoc. M., reinstated Sept. 17, 1940.

DAVIS, DONALD GORDON, Assoc. M., reinstated Sept. 17, 1940.

DE MEY, EDOUARD JEAN BERNARD, M., reinstated Oct. 7, 1940.

DONOHUE, EDWARD BROWN, M., reinstated Sept. 19, 1940.

FOWLER, FRED TRACY, M., reinstated Sept. 21, 1940.

GARNETT, BENJAMIN JAY, M., reinstated Sept. 30, 1940.

HOEFLE, KARL FREDERICK, Assoc. M., reinstated Sept. 25, 1940.

MCCRONE, JOHN ROY, JR., Assoc. M., reinstated Sept. 17, 1940.

MASTRIANI, SAMUEL GABRIEL, Assoc. M., reinstated Sept. 27, 1940.

MIMS, STALEY WOOD, Assoc. M., reinstated Sept. 30, 1940.

REYNOLDS, JOHN THOMAS, Jun., reinstated Sept. 18, 1940.

SHOEMAKER, THEODORE, Assoc. M., reinstated Sept. 17, 1940.

SPAYDE, KEITH CRAWFORD, Assoc. M., reinstated Sept. 20, 1940.

UHLER, EUGENE HENRY, M., reinstated Oct. 3, 1940.

WRIGHT, CLEM WHARTON, M., reinstated Sept. 28, 1940.

WITTE, WALTER EMIL, M., reinstated Sept. 16, 1940.

RESIGNATIONS

DAHL, SVEN TAGE, Assoc. M., resigned Oct. 4, 1940.

GREEN, ARTHUR HENRY, Jun., resigned July 24, 1940.

Applications for Admission or Transfer

Condensed Records to Facilitate Comment from Members to Board of Direction

November 1, 1940 NUMBER 11

The Constitution provides that the Board of Direction shall elect or reject all applicants for admission or for transfer. In order to determine justly the eligibility of each candidate, the Board must depend largely upon the membership for information.

Every member is urged, therefore, to scan carefully the list of candidates published each month in CIVIL ENGINEERING *and to furnish the Board with data which may aid in determining the eligibility of any applicant.*

It is especially urged that a definite recommendation as to the proper grading be given in each case, inasmuch as the grading must be based upon the opinions of those who know the applicant personally as well as upon the nature and extent of his professional experience. Any facts derogatory to the personal character or professional reputation of an applicant should be promptly communicated to the Board.

Communications relating to applicants are considered strictly confidential.

The Board of Direction will not consider the applications herein contained from residents of North America until the expiration of 30 days, and from non-residents of North America until the expiration of 90 days from the date of this list.

MINIMUM REQUIREMENTS FOR ADMISSION

GRADE	GENERAL REQUIREMENT	AGE	LENGTH OF ACTIVE PRACTICE	RESPONSIBLE CHARGE OF WORK
Member	Qualified to design as well as to direct important work	35 years	12 years	5 years RCM*
Associate Member	Qualified to direct work	27 years	8 years	1 year RCA*
Junior	Qualified for sub-professional work	20 years	4 years	
Affiliate	Qualified by scientific acquirements or practical experience to cooperate with engineers	35 years	12 years	5 years RCM*

*In the following list RCA (responsible charge—Associate Member standard) denotes years of responsible charge of work as principal or subordinate, and RCM (responsible charge—Member standard) denotes years of responsible charge of IMPORTANT work, i. e., work of considerable magnitude or considerable complexity.

APPLYING FOR MEMBER

CAMPBELL, NEAL J., St. Louis, Mo. (Age 42) (Claims RCA 7.2 RCM 8.2) Aug. 1934 to date Structural Engr., St. Louis Board of Education.

COBURN, WILLIAM TURLEY (Assoc. M.), Danville, Ill. (Age 55) (Claims RCA 7.2 RCM 19.4) March 1931 to date Utility Officer, Veterans Administration, Danville, Ill.

DAWSON, JAY BOSWORTH, San Francisco, Calif. (Age 59) (Claims RCA 6.8 RCM 25.0) Jan. 1910 to date (except 7 months contracting) Draftsman, Asst. Engr., Asst. Div. Engr., and (at present) Div. Engr., Southern Pacific Co.

FRAZIER, JOHN PROPER, Pittsburgh, Pa. (Age 46) (Claims RCM 20.5) 1936 to date Chf. Engr., Harrison Constr. Co.; previously Senior Asst. Engr., Allegheny County Dept. of Public Works.

GARANFLO, GEORGE EDWIN, Little Rock, Ark. (Age 49) (Claims RCA 6.7 RCM 11.2) Feb. 1940 to date Commr. of Public Works and City Engr., Little Rock; previously with PWA in various capacities.

GIORGI, LUIS, Montevideo, Uruguay. (Age 44) (Claims RCM 17.9) Oct. 1938 to date Engr. in general charge of and responsible for hydroelectric plant of Rincon del Bonete on Rio Negro; previously Director (Dean of Eng. School), Inst. de Maquinas y Decano of Facultad de Ingenieria de Montevideo.

HEATH, WOODSON FEARING, San Benito, Tex. (Age 46) (Claims RCA 8.7 RCM 9.1) Nov. 1933 to date with International Boundary Comm. on Lower Rio Grande flood-control project, as Engr.-in-Chg., Right-of-Way Dept.

HOUSEL, WILLIAM STUART (Assoc. M.), Ann Arbor, Mich. (Age 39) (Claims RCA 6.1 RCM 6.5) Feb. 1924 to 1929 Instructor in, 1929 to 1936 Asst. Prof. of, and 1936 to date Associate Prof. of, Civ. Eng., Univ. of Michigan.

HOWE, HOMER ASA (Assoc. M.), Terre Haute, Ind. (Age 51) (Claims RCA 12.9, RCM 4.8) Aug. 1940 to date in private practice; previously with Miller & Yeager, Archts.

HUTCHISON, ALFRED DRESEL (Assoc. M.), Greenville, Tex. (Age 42) (Claims RCA 11.6 RCM 6.0) June 1920 to date with Texas Highway Dept., as Instrumentman, Res. Engr., Chf. of Party and Asst. Engr., Location Engr., Asst. Div. Engr., and (since Sept. 1933) Res. Engr. and Senior Res. Engr.

JACKSON, BERT BAKER, Long Beach, Calif. (Age 39) (Claims RCA 7.7 RCM 9.5) April 1939 to date with U.S. Housing Authority as Senior Project Engr. and Constr. Adviser for Administrator: Aug. 1938 to April 1939 with FEA of PW; previously with FSA and RA Dept. of Agriculture.

JUDSON, CLAYTON ORTON, St. Joseph, Mo. (Age 52) (Claims RCA 1.6 RCM 28.8) March 1918 to April 1920 Asst. City Engr., and April 1936 to date City Engr.

KAMINSKY, MORRIS MOSES (Assoc. M.), Calumet City, Ill. (Age 39) (Claims RCA 1.2 RCM 15.3) June 1926 to date Chf. Engr., W. J. Holliday & Co., Indianapolis and Hammond, Ind.

KETTLE, KENATH AUSTIN (Assoc. M.), Charleston, W.Va. (Age 35) (Claims RCA 2.4 RCM 6.6) April 1931 to date with Carbide & Carbon Chemicals Corporation, South Charleston, W.Va., as Superv. Engr., and (since March 1934) Chf. Draftsman.

KILIAN, THEODORE PHILIP, Scarsdale, N.Y. (Age 56) (Claims RCA 9.5 RCM 6.0) June 1936 to date Designing Engr., New York City Tunnel Authority; previously with Port of New York Authority as Asst. Engr. and Designer on Lincoln Tunnel.

MEAD, JULIAN CURTIS, Wyandotte, Mich. (Age 54) (Claims RCA 4.3 RCM 23.7) Jan. 1922 to date Designing Engr. of bridges and grade separations, Board of Wayne County Road Commrs.

MENDELSOHN, ISADOR WILLIAM, Washington, D.C. (Age 46) (Claims RCA 10.1 RCM 9.6) July 1940 to date Engr. in Chg., Subsection on design of sewage-treatment plants, Construction Div., QMC, War Dept.; previously Res. Engr. Inspector, PWA, New York City.

NELSON, WILLIAM HOWARD, Seattle, Wash. (Age 53) (Claims RCA 8.4 RCM 16.9) Jan. 1926 to Jan. 1933 and Jan. to Nov. 1934 Asst. Court Engr., and Nov. 1934 to date Court Engr. (Senior Civ. Engr.) City of Seattle, Wash.

RIGGS, EUGENE HOWARD, Pasadena, Calif. (Age 35) (Claims RC 8.8) May 1938 to date Associate Engr., U.S. Engr. Office; previously with Metropolitan Water Dist. of So. Calif., Los Angeles, as Accountant, Acting Purchasing Agent, Asst. Purchasing Agent, and Asst. Engr.

SCHAUB, JOHN GALLUS, Lansing, Mich. (Age 51) (Claims RCA 18.1 RCM 10.0) Nov. 1934 to date with Michigan State Highway Dept., as Asst. Road Constr. Engr., Asst. Road Engr., Road Constr. Engr. and Asst. to Deputy Commr. in Charge of, and (since Jan. 1939) Engr., of Constr. and Operations.

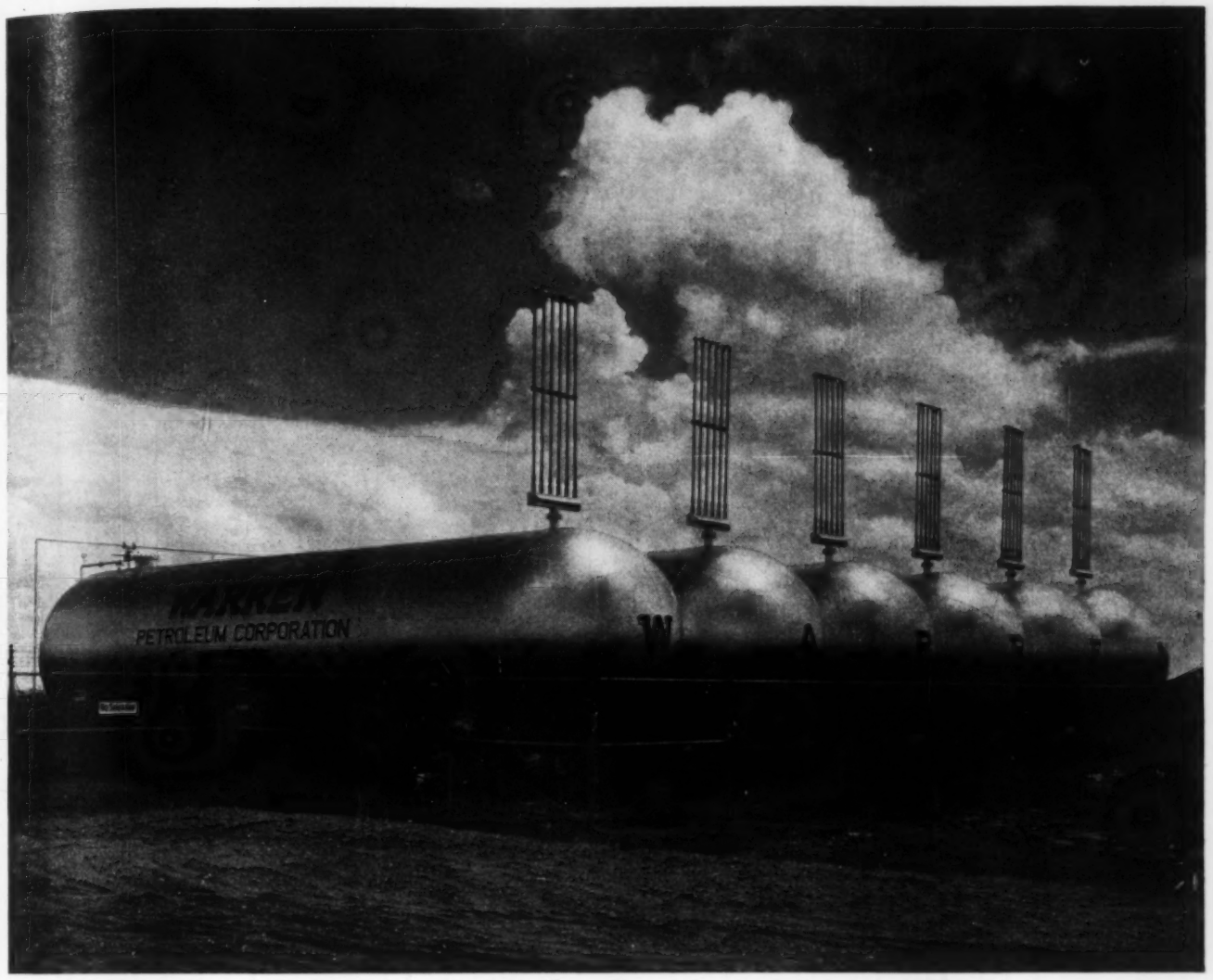
SIMMS, JAMES KENNETH, West Newton, Mass. (Age 40) (Claims RC 11.9 D 4.7) Nov. 1920 to date with United Fruit Co., as Instrumentman, Asst. Engr., Office Engr., and (since Oct. 1927) Engr. at Boston (Mass.) Headquarters, acting as Eng. Asst. to Vice-Pres. and Chf. Engr.

SPARGO, GEORGE EDWARD, Forest Hills, N.Y. (Age 37) (Claims RCM 6.2) Feb. 1934 to date Supt. of Constr. (CWA), Dept. of Parks, New York City.

STEKETEE, RICHARD HENRY, Detroit, Mich. (Age 48) (Claims RCA 1.3 RCM 23.9) July 1924 to date Maintenance Engr., Board of Wayne County (Mich.) Road Commrs.

THOMPSON, MURRAY NIXON (Assoc. M.), Santa Ana, Calif. (Age 52) (Claims RCA 8.1 RCM 11.9) Feb. 1930 to date with Orange County Flood Control Dist., as Acting Engr. in Chg., Engr. in Chg., and (since May 1935) Flood Control Engr.

VOIGT, WILLIAM ADAM, East Lansing, Mich. (Age 39) (Claims RCA 4.8 RCM 6.4) Nov. 1933



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San Francisco ..... 1084 Rialto Bldg.
Los Angeles ..... 1456 Wm. Fox Bldg.

B-781

PLANTS in BIRMINGHAM, CHICAGO and GREENVILLE, PA.

to date with Michigan State Highway Dept., as Bridge Designer, Squad Leader, Chf. Draftsman, and (since Sept. 1936) Engr. of Bridge Design.

WEBER, CARLOS ADAM, East Lansing, Mich. (Age 39) (Claims RCA 10.2 RCM 6.4) June 1920 to date with Michigan State Highway Dept., Lansing, Mich., as Draftsman, Squad Leader, Dist. Office Chf. Draftsman, Asst. Chf. Draftsman, Design Checker, Chf. Road Draftsman, and (since Aug. 1937) Asst. Engr. of Road Design.

WEBER, FREDERICK SPENCER, Lansing, Mich. (Age 37) (Claims RCA 4.7 RCM 6.7) Feb. 1935 to date with Michigan State Highway Dept., as Bridge Designer, Squad Leader in Bridge Design Office, Project Engr., and (since May 1939) Chf. Bridge Draftsman.

APPLYING FOR ASSOCIATE MEMBER

ALPHER, ROBERT JEROME (Junior), Washington, D.C. (Age 32) (Claims RCA 8.7 RCM 0.5) Aug. 1937 to date with Bureau of Air Commerce (now Civil Aeronautics Administration), Commerce Dept., as Airways Constr. Supt., and Asst. Airways Engr.; previously Chf. Architectural Draftsman, and Structural Engr., U.S. Dept. of Agriculture, Bureau of Agri. Eng.

BREWSTER, GEORGE COLBY, Kansas City, Mo. (Age 47) (Claims RCA 8.5) April 1920 to date with Black & Veatch, Cons. Engrs., as Asst. Res. Engr., and (since 1921) Res. Engr.

BUDNIK, CASS A., Somerset, Pa. (Age 39) (Claims RCA 5.1 RCM 1.5) April 1939 to date Res. Engr., Pennsylvania Turnpike Comm.; previously Gen. Foreman, Bent Bros. Co. and Griffith, Inc., Conchas Dam, N.Mex.; Field Engr., Winston & Crowell Co.

CORFITZEN, WILLIAM EDWARD (Junior), Denver, Colo. (Age 32) (Claims RCA 3.1 RCM 2.2) Nov. 1933 to date with U.S. Bureau of Reclamation, as Jun. Engr., and (since June 1937) Asst. Engr.

CROPPER, GEORGE BERTRAND (Junior), Ocean City, Md. (Age 32) (Claims RCA 3.1 RCM 2.3) Jan. 1939 to date consulting practice; previously Jun. Engr., U.S. Engr. Dept., Baltimore, Md.

DESAI, THAKORLAL DAYALJI, Bombay Province, India. (Age 30) (Claims RCA 5.3) Oct. 1939 to date with the Military Service of Engrs. as Surveyor of Works Asst., Grade 1, at Jubbelpore; previously Asst. Engr., with M/S. Mckenzies Ltd. Bombay, India.

GEVECKER, VERNON ARTHUR CHARLES (Junior), Rolla, Mo. (Age 31) (Claims RC 1.1 D 0.5) Sept. 1934–May 1935 Graduate Asst., Sept. 1938–Aug. 1940 Instructor in, and Sept. 1940 to date Asst. Prof. of, Civ. Eng., Missouri School of Mines.

GOLDBERG, IRVIN JAY, North Little Rock, Ark. (Age 30) (Claims RC 5.4 D 7.2) July 1933 to date with Arkansas Highway Comm. as Designer-Squad Boss, and (since March 1936) Squad Boss.

HARKER, JOSEPH CLYDE (Junior), Redding, Calif. (Age 32) (Claims RCA 3.5) Feb. 1940 to date took Civil Service examination for Jun. Engr.; since July 1940 acting as Inspector, Grade 9, U.S. Bureau of Reclamation; previously Jun. Engr. (Civ.), and Senior Eng. Aide, U.S. Engr. Office, and Jun. Civ. Engr., Asst. Chf. Engr.'s Office, both of Los Angeles.

HARRISON, RICHARD EDGCOMB, Cochituate, Mass. (Age 37) (Claims RCA 1.0) Sept. 1930 to date with Metropolitan Dist. Water Supply Comm., as Instrumentman, Chf. of Party and Asst. Civ. Engr.

HOPKINS, CHARLES DEWITT, Chevy Chase, Md. (Age 47) (Claims RCA 4.6 RCM 9.3) Oct. 1937 to date with WPA, as Massachusetts State Staff Consultant, and (since June 1940) Geodetic Engr., Eng. Div., Washington, D.C.; previously in private practice.

HOWELL, JOHN TUDHOPE (Junior), Balboa Heights, C.Z. (Age 31) (Claims RCA 5.7) Oct. 1940 to date Associate Engr., The Panama Canal; Jan. 1937 to Oct. 1940 Structural Engr., Portland Cement Association, Chicago, Ill.; previously Jun. Engr. and Asst. Engr., U.S. Bureau of Reclamation, Denver, Colo.

HUEBNER, CARL HERMAN (Junior), Newark, N.J. (Age 28) (Claims RCA 3.0 RCM 1.0) July 1935 to date Asst. Supervisor of Acquired Property, Metropolitan Life Insurance Co., Comptroller's Div., New York City.

JOHNSON, LOYS ALMON (Junior), Charleston, S.C. (Age 32) (Claims RCA 4.5 RCM 2.4) Dec. 1939 to date Lieut. (j.g.), CEC, U.S. Naval Reserve; previously Asst. Structural Engr., Design Div., TVA, Knoxville, Tenn.; Designer, Central Nebraska Public Power and Irrigation Dist., Hastings, Nebr.; Jun. Engr., Bureau of Reclamation, Denver, Colo.

JONES, DOUGLAS KENT, Ithaca, N.Y. (Age 32) (Claims RCA 1.0) May 1939 to date McMullen Research Fellow, Cornell Univ.; Feb. to May 1939 Cooperative Agent, SCS; previously Soil Tester, Utah State Road Comm.; Instructor in Civ. Eng., Univ. of Utah.

JONES, EDWIN YOWELL, Tiquisate, Guatemala. (Age 32) (Claims RCA 2.1 RCM 2.0) Aug. 1936 to date with Cia. Agricola de Guatemala as Project Engr., and (since Oct. 1938) Chf. Engr.; previously with United Fruit Co., as Field Engr., Asst. Roadmaster and Engr.

KABRICH, CHARLES EDWARD (Junior), Catawba Sanatorium, Va. (Age 32) (Claims RCA 1.0 RCM 1.0) Dec. 1938 to date at Catawba Sanatorium as Owner's Representative, and (since Oct. 1939) Executive Asst.; previously Owner's Representative, Pulaski (Va.) County School Board; Foreman and Inspector, Arthur G. McKee & Co., Pulaski, Va.; 1st Lieut., U.S. Army with CCC.

KAMPMEIER, ROLAND AUGUST (Junior), Knoxville, Tenn. (Age 29) (Claims RCA 4.1) Sept. 1939 to date Associate Prof. of Hydr. and San. Eng., Univ. of Tenn.; previously and since Feb. 1940 with TVA, successively as Jun. Engr., Asst. Hydr. Engr., Associate Hydr. Engr. and Power Supply Engr.

KJELLMAN, VICTOR HARRY (Junior), Boston, Mass. (Age 32) (Claims RCA 1.8) Oct. 1935 to date with U.S. Engrs., as Student Engr., Jun. Engr., and (since June 1939) Asst. Engr.

KULLESEIDE, OLAV, West New Brighton, N.Y. (Age 39) (Claims RCA 6.3 RCM 1.0) Sept. 1940 to date Designer, Francisco and Jacobus, Engrs. and Archts., New York City; previously Designer, Sigurd Lund & Asbj. Aass, Cons. Engrs., Oslo, Norway; Draftsman and Designer, Halv Hjorth, Cons. Engr., Oslo, Norway; Asst. Prof. of Statics and Structural Design, Technical Inst. of Norway; Draftsman, Erie R.R. Co., Cleveland, Ohio.

LEE, ALLAN, Baltimore, Md. (Age 39) (Claims RCA 11.4 RCM 2.0) July 1929 to date Jun. Asst. Bridge Engr., Maryland State Roads Comm.

LEONARD, GEORGE PERRY, Ogallala, Nebr. (Age 35) (Claims RCA 12.9) Jan. 1928 to date Gen. Supt., Martin Wunderlich Co., Contrs., Jefferson City, Mo.

LUCKS, LLOYD FREDERICK, San Francisco, Calif. (Age 33) (Claims RCA 6.9) Dec. 1937 to date Land Appraiser, Assessor's Office, City and County of San Francisco; previously Hydr. Engr., San Francisco Water Dept.

MACMILLAN, WILLIAM WILSON (Junior), Glendale, Calif. (Age 32) (Claims RCA 3.9) Oct. 1933 to date with Metropolitan Water Dist. of So. California as Inspector and Engr., etc.

MARRERO, WILLIAM THOMAS, Chicago, Ill. (Age 32) (Claims RCA 3.2 RCM 2.0) Aug. 1930 to Nov. 1932, Structural Designer and Asst. Squad Leader, Dept. of Subways, and April 1938 to date Asst. Subway Designer, Dept. of Subways & Superhighways, City of Chicago; in the interim Structural Designer, Armour & Co., Chicago.

MORTIMER, WINFIELD STOUT (Junior), Spokane, Wash. (Age 33) (Claims RCA 2.2) May to Dec. 1936 and April 1937 to date with Washington State Dept. of Highways in various capacities; at present loaned to Joseph H. Wohleb, Archt., Olympia, Wash.; in the interim with W. L. Malony, Cons. Engr., Spokane.

MORTON, RUSSELL JULIUS, West Point, Ga. (Age 34) (Claims RC 4.5) April 1936 to date Gen. Supt., Chf. Engr. and Valuation Engr., Chattahoochee Valley Ry. Co.; previously with United Fruit Co., as Engr., Truxillo R.R. Co., Pto. Castilla, Honduras.

NOFERI, LOUIS ERNEST (Junior), New York City. (Age 33) (Claims RCA 4.6) Feb. 1931 to Dec. 1932 and April 1938 to date Eng. Asst., Grade 3, Board of Transportation; in the interim Structural Draftsman, Gibbs & Hill, Inc.; Asst. Engr. with Borough Pres. of Manhattan, U.S. PWA.

NORRIS, GEORGE EDWARD, Clarksburg, W.Va. (Age 40) (Claims RCA 11.6) June 1917 to date with Baltimore & Ohio R.R., as Secy. to Asst. to Chf. Engr., Chainman, Rodman, Inspector, Transitman, and (since Oct. 1935) Field Engr.

RIKER, WARREN NEWTON, Tenafly, N.J. (Age 30) (Claims RCA 7.3) 1932 to date with James Stewart & Co., Gen. Contrs., New York City as Senior Engr., Asst. Supt., and Engr.

RODEWALD, FREDERICK ARTHUR, San Benito, Tex. (Age 47) (Claims RC 7.0 D 3.5) 1936 to date Senior Eng. Draftsman, U.S. and Mexico International Boundary Comm.; previously on various jobs.

SAPIRIE, SAMUEL RALPH, Milwaukee, Wis. (Age 31) (Claims RCA 5.2 RCM 5.2) March 1939 to date Engr., SCS, Regional Div. of Eng.; previously with USDA as Engr. Technician and Associate Constr. Engr., ECW, State Forestry Div. of Indiana, Regional Engr., Div. of Land Utilization (RA, FSA, BAE), and Chf., being Acting Senior Engr. in charge of Div. of Land Development and Div. of Land Utilization (BAE).

SCHEVE, CARL JULIUS (Junior), Norfolk, Va. (Age 32) (Claims RCA 2.7) March 1937 to date Lieut. (j.g.), C.E.C., U.S. Navy, acting as Asst. Public Works Officer; previously Jun. Engr., U.S. Bureau of Reclamation, Denver, Colo.

SENKPIEL, WILLIAM CHRISTIAN GUSTAVE (Junior), Denver, Colo. (Age 32) (Claims RCA 7.9) June 1929 to date with Conservation Branch, U.S. Geological Survey as Jun. Hydr. Engr., Asst. Hydr. Engr., Associate Hydr. Engr., and (since Aug. 1938) Hydr. Engr.

SHAW, BARTON HARRINGTON (Junior), Cincinnati, Ohio. (Age 32) (Claims RCA 4.1) June 1934 to May 1937 and Dec. 1937 to date with U.S. Engr. Office as Eng. Draftsman and after March 1937 Jun. Engr.; in the interim Engr., V. P. Serodino Co., and Field Engr., David Gordon Bldg. & Constr. Corporation, both of Cincinnati, Ohio.

SHUPE, ELMER BYRON, Troy, N.Y. (Age 45) (Claims RCA 17.1 RCM 2.8) Aug. 1940 to date Civ. Engr., Bureau of Yards & Docks, Navy Dept., New York City; Feb.–June 1940 Associate Hydr. Engr. (Expert), Div. of Power-Flood Control Surveys, Federal Power Comm., Washington, D.C.; previously Asst. Engr., and Hydr. Engr., Board of Hudson River Regulating Dist.

SPARKS, THOMAS CARR, Catonsville, Md. (Age 36) (Claims RCA 6.0 RCM 4.9) March 1923 to date with Baltimore & Ohio R.R. Co., successively as Chainman, Rodman, Leveler, Inspector, Transitman, Asst. to Field Engr., Field Engr., and (since May 1939) Industrial Engr.

STERMITZ, FRANK, Helena, Mont. (Age 33) (Claims RCA 5.0 RCM 3.5) July 1930 to Sept. 1936 Jun. Engr., and Sept. 1936 to date Asst. Engr., Water Resources Branch, U.S. Geological Survey.

SULLIVAN, EUGENE BINGHAM (Junior), East Hartford, Conn. (Age 32) (Claims RCA 4.3) June 1940 to date Town Engr., East Hartford, Conn.; June 1933 to June 1940 with Connecticut State Highway Dept., as Engr.'s Helper, Rodman, Transitman, Chf. of Party, and Jun. Highway Engr.

VALDES, AGUSTIN MANUEL, Mexico, D.F., Mexico. (Age 38) (Claims RCA 13.8) Jan. 1931 to date Chf. Engr., Conservancy of Valley of Mexico; at present Commr., International Boundary Comm.

VAUGHAN, EVAN WILLIAM (Junior), Balboa, Canal Zone. (Age 32) (Claims RCA 3.0 RCM 2.3) June 1939 to date Chf. Soil Technician, The Panama Canal; previously with TVA, Knoxville, Tenn., as Eng. Aide and Asst. Hydr. Engr.

WINTERKORN, HANS FRIEDRICH, Columbia, Mo. (Age 34) (Claims RCA 2.0 RCM 7.0) Sept. 1931 to date with Missouri State Highway Dept., Jefferson City, Mo., as Soil Research Engr., and (since 1932) Research Consultant; also, since 1932 at Univ. of Missouri as Visiting Asst. Prof. in Physical Chemistry and (since 1933) Research Associate on Soils.

YOUNG, CARLOS, Montevideo, Uruguay. (Age 36) (Claims RCA 4.3) 1932 to date with Govt. Comm. of Hydro-Electric Studies as Executive Engr., and (since Oct. 1937) Asst. Engr. of Executive Board of Hydro-Electric Studies.

APPLYING FOR JUNIOR

ALECK, BENJAMIN JACOB, Cincinnati, Ohio. (Age 23) 1938 C.E. and Sept. 1938 to June 1939 graduate student, Cornell Univ.; Aug. 1939 to date Jun. Engr., U.S. Engrs.

BEDENIK, JACOB JAMES, Milwaukee, Wis. (Age 30) (Claims RCA 2.3) April 1940 to date Inspector (dredging), U.S. Engr. Office, War Dept.; previously Jun. Engr., Regional Planning Dept., Milwaukee County, Wis.; Draftsman, Wisconsin Bridge & Iron Co.; Instrumentman, RA, Ironwood Homesteads, Mich.; Jun. Engr., CWA and WPA.

BOWMAN, JOSEPH RICHMOND, Norfolk, Va. (Age 25) 1939 B.S. in C.E., Univ. of Tenn.; July–Sept. 1939 and Jan. 1940 to date with U.S. Engr. Office in Soils Laboratory, and (since July 1940) in Hydr. Sec.; in the interim Engr. and Jun. Inspector, Hawarden (Iowa) Natural Gas Co.; Draftsman and Tracer, Harza Eng. Co., Chicago, Ill.

BUCHTA, MARION ARTHUR, Lincoln, Nebr. (Age 28) (Claims RC 0.3 D 0.7) June 1939 to date

R. L. LAWRENCE, Jr.

(Superintendent and Chief Engineer, Water Works Department, Nashville, Tennessee)

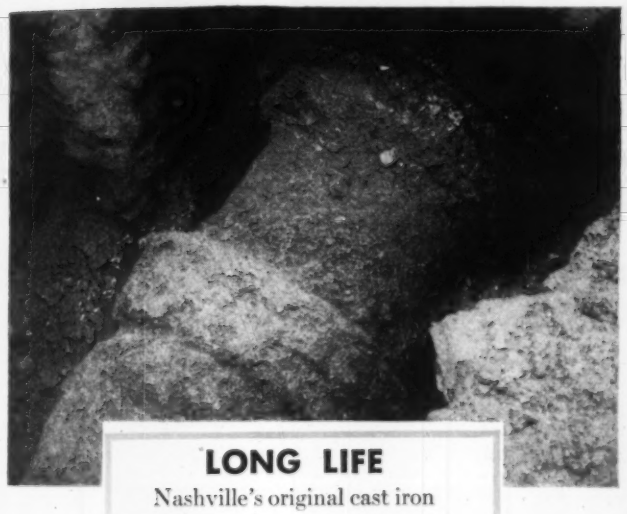
writes:

"Although we have cast iron pipe in our system over 100 years of age, the only photographs available are of 24-inch pipe laid 59 years ago in the congested uptown section of the City. Several hundred feet of this line, which traversed the site of our new City-County Building, was recently removed and, being in excellent condition, will ultimately be placed back in service elsewhere. The maintenance cost per mile of this old line has been approximately $5.44 per year."

R. L. Lawrence Jr.

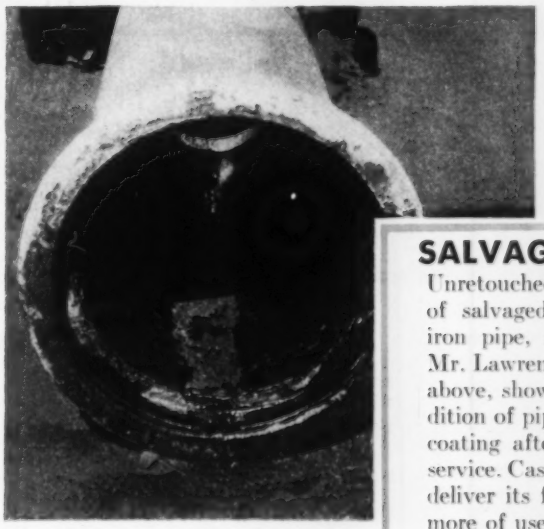
LOW MAINTENANCE

is an economy feature of cast iron pipe that is proved by water works records the nation over. An impartial survey among 195 water works superintendents shows that the maintenance cost of cast iron pipe is far below that of any other pipe material which has been in use long enough for the recording of conclusive data.



LONG LIFE

Nashville's original cast iron water main, still in service, was laid one year after New York's 109 year-old cast iron main, shown in the accompanying unretouched photograph. Many millions in tax dollars have been saved by the long life, low maintenance cost and salvage value of cast iron pipe.



SALVAGE VALUE

Unretouched photograph of salvaged 24-inch cast iron pipe, referred to in Mr. Lawrence's statement above, showing good condition of pipe and interior coating after 59 years of service. Cast iron pipe will deliver its full century or more of useful life, in one location or another, as changed conditions may require.

Water mains represent about one-third of this country's 5-billion-dollar investment in public water supply systems. More than 98% of these mains are cast iron pipe with a *known* useful life at least double the *estimated* life of other water main materials. Because the tax-saving, through avoiding replacements, is enormous, cast iron pipe is known as Public Tax Saver No. 1.

CAST IRON

Look for the "Q-Check" Registered trade mark. Cast iron pipe is made in diameters from 1¼ to 84 inches.

THE CAST IRON PIPE RESEARCH ASSOCIATION, THOMAS F. WOLFE, RESEARCH ENGINEER, 1015 PEOPLES GAS BUILDING, CHICAGO, ILLINOIS

CAST IRON PIPE

PUBLIC TAX SAVER NO. 1

(while graduate student) Operator, Loup River Public Power Dist.; previously with Central Nebraska Public Power & Irrigation Dist., as Draftsman, Designer, and Engr.-Inspector; Engr.-Estimator, WPA.

BURTNER, B PARRISH, Sulphur Springs, Tex. (Age 24) 1940 B.S. in Civ. Eng., Tex. A. & M. Coll.; Oct.–Nov. 1935, April to Sept. 1936 and July 1940 to date Chainman and Rodman, with Texas Highway Dept.

CLAYTON, FREDERICK WILLIAM, San Diego, Calif. (Age 27) 1940 B.S. in Civ. Eng., Univ. of Nev.; July 1940 to date with City of San Diego as Jun. Draftsman and (since Aug. 1940) Jun. Engr. (Hydraulic Design), Water Dept., Div. of Development and Conservation.

DESS, RICHARD CARL, Paris, Tenn. (Age 24) 1940 B.C.E., Marquette Univ.; March 1938 to date with TVA as Student Engr., and (since June 1940) Asst. Eng. Aid.

EVANS, ROGER VIRGIL, Lincoln, Nebr. (Age 30) 1940 B.S. in Civ. Eng., Univ. of Nebr.; June 1934 to Sept. 1938 Eng. Aid, SCS, U.S. Dept. of Agriculture.

GILCHRIST, FRANK, Dallas, Tex. (Age 22) 1939 B.S. in Eng. Adm., Tex. A. & M. Coll., June 1939 to date with City of Dallas, Tex., since July 1940 as Asst. Budget Officer.

GROVES, GEORGE ROBERT, JR., Dallas, Tex. (Age 29) (Claims RCA 3.5) Feb. 1936 to date Salesman and Estimating Engr., Reliance Clay Products Co.

KETCHEN, LAWRENCE LINDBERG, Quonset Point, R.I. (Age 27) 1936 B.S.C.E., Northeastern Univ.; Aug. 1940 to date Jun. Civ. Engr., U.S. Navy; previously Senior Eng. Aide, Metropolitan Dist. Water Supply Comm.; Draftsman, Whitman & Howard; Safety Inspector, Employers Liability Assurance Co.; Draftsman and Photographer, New England Survey Service.

KNAPP, WILLIAM HARRISON, Philadelphia, Pa. (Age 29) Aug. 1934 to July 1935, April to Oct. 1937 and June 1938 to date with United Engrs. & Constrs. Inc., as Eng. Asst., Levelman, Inspector and Field Engr.

KNEELAND, WILLIAM FREDERICK, Ames, Iowa. (Age 25) (Claims RC 1.2) At present graduate student, Iowa State Coll.; June 1936 to Jan. 1940 and June to Sept. 1940 with North Dakota State Highway Dept., as Rodman, Instrumentman, Inspector, Res. Engr., Structural Draftsman.

MCCANDLESS, CHARLES SPRAGUE, Los Angeles, Calif. (Age 22) 1939 A.B. in Eng., Stanford Univ.; Aug. 1940 to date Field Engr., F. J. Twaits-Morrison Knudson Constr. Companies; previously Job. Engr., Ford J. Twaits Constr. Co.; Head Chainman and Concrete Inspector, H. J. Kaiser Constr. Co.

MANEY, JOSEPH THOMAS, Lakewood, Ohio. (Age 26) July 1940 to date Engr., Republic Steel Corporation; July 1937 to July 1940 Draftsman, Bureau of Bridges, Ohio State Highway Dept., Columbus; previously Asst. City Engr., Conneaut, Ohio.

QUINTERO, ANDRES GARCIA, Mexico City, Mexico. (Age 30) (Claims RC 5.9 D 4.4) July 1936 to date Ingeniero Auxiliar, Comision Nacional de Irrigacion; previously Ingeniero Sub-Auxiliar, Secretaria de Agricultura y Fomento.

ROSS, HENRY ALBERT, Sacramento, Calif. (Age 27) Oct. 1939 to date Engr. Inspector, U.S. Engrs., Auburn, Calif.; Feb. to Oct. 1939 Jun. Engr. Inspector, PWA; Dec. 1937 to Jan. 1939 Instrumentman, State Dept. of Architecture; previously Senior Eng. Aide, California Div. of Highways; Surveyman with C. C. Young, and with R. R. Randall, Oakland, Calif.

SEAWORTH, GEORGE HENRY, Bismarck, N.Dak. (Age 27) (Claims RC 1.7) Sept. 1935 to date with North Dakota Highway Dept., as Structural Draftsman, and (since Jan. 1939) Structural Designer.

SIMS, FLOURNOY WILLIAM, Little Rock, Ark. (Age 28) (Claims RCA 1.6) March 1938 to date Jun. Engr., U.S. Engr. Office; previously Analytical Chemist, Testing Engr. and Inspector, Van Trump Testing Laboratory, and Chemist and Research Engr., Stebbins and Roberts, Inc., both of Little Rock; Chemist, Arkansas Bauxite Corporation.

STEWART, WILLIAM KENNETH, Tulsa, Okla. (Age 24) 1939 B.S. in Civ. Eng., Okla. A. & M. Coll.; Sept. 1939 to date Eng. Aide, U.S. Engr. Office.

VALLEI, QUINTO, Washington, D.C. (Age 28) June 1939 to date Structural Engr. (P-1), Office of Quartermaster General, U.S. War Dept., Design Branch, Ft. Myer, Va.; previously Structural Steel Detailer, Widdicombe Eng. Co., Philadelphia, Pa.; Structural Draftsman, Hunter & Caldwell, Archts., Altoona, Pa.; with Globe Contr. Co.; Estimator and Constr. Service Salesman, Catapano Holding Corporation, Brooklyn, N.Y.

WEBBER, HAROLD EVERETT, San Rafael, Calif. (Age 29) (Claims RCA 0.8) Sept. 1936 to date with California Dept. of Public Works, Div. of Highways, as Under Eng. Aide, Dist. IV Drafting Room, and Jun. Eng. Aid; previously with City Improvement Club, Willits, Calif.

1940 GRADUATES

POL. INST. OF BROOKLYN (B.C.E.)

BUSH, ALFRED (23)

COLUMBIA UNIV. (M.S. in C.E.)

FRANKE, HAROLD HUGO (22)
(Also 1939 B.S. in C.E., Univ. of Md.)

GA. SCHOOL TECH. (B.S. in C.E.)

BIRDSALL, JOHN WILBUR (23)

UNIV. OF ILL. (B.S. in C.E.)

CONWAY, LEE FRANKLIN (21)
NEELY, ELMER ALLEN (23)

KANS. STATE COLL. (M.S.)

YOUNG, JOHN HENRY (24)
(Also 1939 B.S. in C.E.)

LEHIGH UNIV. (B.S. in C.E.)

SCARPULLA, NORMAN CHARLES (23)

UNIV. OF MINN. (B.C.E.)

BREDVOLD, LLOYD MILO (26)

NORTHWESTERN UNIV. (B.S. in C.E.)

MCCONACHIE, JAMES LLOYD (21)
STAHL, JOHN VERNON (22)
WISS, JOHN FRANK (21)

TUFTS COLL. (B.S. in Civ. Eng.)

OCCHIPINTI, SEBASTIAN JAMES (22)

VA. MIL. INST. (B.S.C.E.)

FLOWERS, FRED FORT (20)

The Board of Direction will consider the applications in this list not less than thirty days after the date of issue.

Men Available

These items are from information furnished by the Engineering Societies Personnel Service, Inc., with offices in Chicago, Detroit, New York, and San Francisco. The Service is available to all members of the contributing societies. A complete statement of the procedure, the location of offices, and the fee is to be found on page 132 of the 1940 Year Book of the Society. To expedite publication, notices should be sent direct to the Personnel Service, 31 West 39th Street, New York, N.Y. Employers should address replies to the key number, care of the New York office, unless the word Chicago, Detroit, or San Francisco follows the key number, when it should be sent to the office designated.

CONSTRUCTION

CIVIL ENGINEER; M. Am. Soc. C.E.; B.S., C.E.; licensed professional engineer; 30 years experience in charge of heavy construction projects including dams, powerhouses, bridges, and mills; 3 years in charge of the Maine State-Wide Highway Planning Survey. C-777.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 23; married; B.S. in C.E., University of Maryland; desires position on construction of steel and reinforced concrete structures, preferably bridges; 2 years experience on major bridge project as instrumentman and inspector, including foundations, pile driving, precise triangulation, and alignment of beam, truss, and girder spans. C-779.

PLANT ENGINEER; Assoc. M. Am. Soc. C.E.; 40; for general engineering supervision of maintenance and new construction for plant or large institution; 17 years unusually broad experience in steel, concrete, surveying, gas and electric utility structures, including gas mains, pole lines, right-of-way problems, electrical and mechanical equipment, design, specifications, contracts, purchasing. C-782.

GRADUATE CIVIL ENGINEER; Assoc. M. Am. Soc. C.E.; licensed; 25 years experience on construction—20 with contractors, 5 with federal and city government; employed as project manager, superintendent of construction, estimator, and contractor; knows construction costs; can design sewage disposal, bulkheads, water works, heavy construction, public works, buildings. C-784.

EXECUTIVE

PROMOTIONAL ENGINEER; M. Am. Soc. C.E.; 40; Belgian, first papers; M.S. in C.E., Massachusetts Institute of Technology; 7 years experience in design, construction of reinforced concrete and steel structures; 9 years executive director of collective organization for promotion of uses of steel; speaks English, Spanish, French; wide traveling in Europe and Africa; qualified to organize promotional work, particularly in export market for engineering product or material. C-781.

ENGINEER EXECUTIVE; M. Am. Soc. C.E.; 22 years in consulting engineer's office; 12 years, federal engineering; civil, hydraulic, hydroelectric office, and field engineer; technical investigations, reports, design, construction, cost estimates; dams, hydroelectric plants, transmission lines, pipe lines, flood control, buildings. Commercial experience, export and domestic; department manager handling purchases, sales, and claims. C-785.

INDUSTRIAL

SAFETY ENGINEER; M. Am. Soc. C.E.; available for full-time or for part-time service anywhere east of Kansas City and north of Louisville. C-780.

JUNIOR

CIVIL ENGINEER; 29; Jun. Am. Soc. C.E.; B.S. in C.E.; 2½ years on highways, field and materials laboratory; 1 year triangulation; 1 year hydraulic model studies; 2 years report writing on flood control, navigation, etc.; location immaterial; desires opportunity for advancement; salary of minor importance. C-776.

JUNIOR ENGINEER; Jun. Am. Soc. C.E.; 23; married; prefers design, sales, surveying, or office work; location South America because of knowledge of Spanish; available upon notice. C-778-409-A-3. San Francisco.

RESEARCH

CIVIL ENGINEER; Assoc. M. Am. Soc. C.E.; California license; desires position covering research, planning, statistics, reports on development and economic utilization of land, etc.; writer, speaker, and public relations; exceptional experience; available now; location immaterial. C-783.

HIGHWAYS FOR

NORMAL PEACE-TIME NEEDS

OR NATIONAL DEFENSE

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● There are a great many reasons for putting highway and airport construction plans in gear with the stepped up pace of army mechanization. Roads, bridges and airports are vital to a fully mechanized army. But these same facilities are of almost equal importance to the development of any community highway system in peace time.

For instance, an adequate system of secondary roads for defense makes it possible to move troops into an area while evacuating civilians. But these same secondary roads in peace time would relieve the Sunday and holiday traffic on main highways.

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BRIDGES

CONCRETE, BATON ROUGE, LA. Louisiana Tries Low Heat Cement, H. L. Lehman and E. L. Erickson. *Eng. News-Rec.*, vol. 125, no. 11, Sept. 12, 1940, pp. 353–354. Cracking in concrete of piers and roadway slab of Baton Rouge bridge in Louisiana reduced to minimum by use of modified portland cement of low-heat type, manufactured to specification that differs from that for standard portland cement only in that tricalcium aluminate is limited to 7%, and ratio of percentage of iron oxide to aluminum oxide to 1.50.

CONCRETE, WASHINGTON. Design Details of Interest on Small Concrete Bridges, E. A. White. *Western Construction News*, vol. 15, no. 7, July 1940, pp. 242–245. Design and construction of two short-span reinforced concrete highway bridges in Pierce County, Wash., featuring hollow girders with plywood forms left in place; pile caps eliminated by heavy deck-slab reinforcing; cost data.

CONCRETE FRAME, CANADA. Short Cuts in Designing Continuous Frame Bridges, E. J. Napier. *Roads & Bridges*, vol. 78, no. 8, Aug. 1940, pp. 11–13, 42, and 45–46. Design procedure for proposed 5-span reinforced concrete structure, 222 ft long, on Don Mills road over Canadian National Railways main line near Oriole, Ont.; span arrangement; moving wheel load computations; use of force polygon; determining influence ordinates; rigidity of supports.

CONSTRUCTION, DERRICKS. Floating Tower Derrick Erects Arch Spans Over Susquehanna River. *Construction Methods*, vol. 22, no. 7, July 1940, pp. 66, 84, and 86. Description of floating tower derrick, with over-all vertical reach exceeding 200 ft, for erection of steel trusses and lateral bracing of two 456-ft arch spans crossing Susquehanna River, at Havre de Grace, Md.

DESIGN. Bridge Design in New South Wales. *Civ. Eng.* (London), vol. 35, no. 409, July 1940, pp. 198–200. Review of 10-year progress in study of factors affecting design and construction of bridges, with special reference to following: Duration of storms, earth pressures, retaining walls, bearing capacity of piles, hollow core piling, cantilevered slabs, saving in weight, welding and riveting, opening spans, vibrated concrete.

FOUNDATIONS. Steel Pile Bridge Piers on Canadian National Railways. *Engineer*, vol. 170, no. 4409, July 12, 1940, pp. 20–23. New departure from standard practice consists in use of steel H-bearing piles, driven to unusually great depths, and used not only as bearing structure below ground, but also to form pier itself; steel piles in each group are braced together, all connections being welded; application to several bridges described and illustrated.

HIGHWAY, MAINTENANCE AND REPAIR. County Bridge Maintenance, L. W. Brunson. *Roads & Streets*, vol. 83, no. 8, Aug. 1940, pp. 62, 64, and 68. Review of practice of Kent County, Mich., in maintaining and repairing of smaller highway bridges, with special reference to methods of welding repairs on steel truss bridges; construction of modern "bedstead type" bridge; arc welded ice breakers constructed to protect bridges.

HIGHWAY, PENNSYLVANIA. 307 Bridges for Pennsylvania Turnpike Comprise Four Major Types. *Construction Methods*, vol. 22, no. 8, Aug. 1940, pp. 64–66 and 106–108. Features of several types of drainage and grade-separation structures on Pennsylvania Turnpike, including rigid-frame overhead structures, I-beam structures for undergrade crossings, viaducts, etc.

LIFT, CLEVELAND, OHIO. Three Methods for Erecting Lift Bridges, G. B. Sowers. *Eng. News-Rec.*, vol. 125, no. 5, Aug. 1, 1940, pp. 166–168. Description of three different methods of erection used in construction of three similar vertical-lift bridges over Cuyahoga River at Cleveland, Ohio.

PLATE GIRDER, CONNECTICUT. One-Leg Bents Support Steel Grid Deck, W. G. Grove. *Eng. News-Rec.*, vol. 125, no. 11, Sept. 12, 1940, pp. 328–331. Design and construction of highway bridge over Housatonic River between Stratford and Milford, Conn.; use of canopy type towers; or "one-leg bents," at two of piers; use of open-grid steel deck for entire length of bridge; consisting of 12 spans totaling 1,824 ft in length; pier design.

PONTOON, SEATTLE, WASH. World's Largest Floating Structure, Newly Completed Lake Washington Pontoon Bridge—Unique Engineering Feat, C. F. A. Mann. *Pac. Mar. Rev.*, vol. 37, no. 8, Aug. 1940, pp. 32–34. Floating bridge, with 6,561-ft floating section stretching across middle of great deep lake has total displacement tonnage in excess of 100,000; notes on construction.

STEEL. Bridges Given Deep Roots with Steel H-Section Piles. *Ry. Age*, vol. 109, no. 5, Aug. 3, 1940, pp. 178–182. Description of four bridges, with deeper foundations and wider openings, constructed by Union Pacific Railroad at important crossings on Mojave River in Southern California with view to minimizing damage by floods which periodically threaten river.

STEEL TRUSS, CONTINUOUS. Adjustment of Continuous Bridge Affected by Warping, L. T. Wyly, T. I. Fullenwider, and R. B. Murphy. *Eng. News-Rec.*, vol. 125, no. 9, Aug. 29, 1940, pp. 280–282. Use of Morehouse proving rings for direct measurement of end-reactions of continuous spans of steel truss highway bridges over Illinois River, showing important effect of warping of spans on magnitude of stresses.

STEEL TRUSS, PORT ARTHUR, TEX. Port Arthur-Orange Bridge, Texas, U.S.A. *Engineering*, vol. 150, nos. 3886, 3889, and 3892, July 5, 1940, pp. 1–4; July 26, pp. 64–66; and Aug. 16, pp. 121–122, and 130, supp. plates. Illustrated description of viaduct-type bridge providing vertical clearance of 176 ft, horizontal clearance of 600 ft; estimated cost $2,500,000; bridge proper is of cantilever type with central suspended span, 400 ft long; main piers are at 680-ft centers; and cantilever arms forming adjacent spans are each 374 ft long; total length 7,752 ft.

STEEL TRUSS, RHODE ISLAND. Jamestown Bridge Has 640-Ft Cantilever Span. *Construction Methods*, vol. 22, no. 8, Aug. 1940, pp. 70–71 and 108. Features of new steel truss bridge crossing Narragansett Bay near Saunderstown, R. I., having total length of 6,600 ft including main cantilever span of 640 ft with clearance of 135 ft above mean high water; building and bridge substructure involving 32 concrete piers, some founded directly on rock and others on piles.

SUSPENSION, PAINTING. Bridge Paint Is Steam-Cleaned. *Eng. News-Rec.*, vol. 125, no. 7, Aug. 15, 1940, pp. 238–239. Experience with painting maintenance of San Francisco–Oakland Bay suspension bridge, including description of portable steam cleaning unit alleged to clean better than old style brushing method at one-fifth cost.

VIADUCTS, CHICAGO, ILL. Bridging Busy Electrified Tracks, L. T. Smith and L. C. Riggle. *Eng. News-Rec.*, vol. 125, no. 7, Aug. 15, 1940, pp. 210–212. Reconstruction of obsolete viaduct over electrified tracks of Michigan Central and Illinois Central Railroads, in Chicago, featuring pinned hangars at expansion joints of girders, deck that is considerably wider than foundations, concrete-filled steel grid roadway, cast-iron ornamental fascia plates, and rolled steel ornamental railings; construction safety devices; cost $235,000.

WOODEN, MAINTENANCE AND REPAIR. Field Problems Involved in Redecking Timber Bridge. *Western Construction News*, vol. 15, no. 8, Aug. 1940, pp. 269–270. Methods of redecking Sonoma Creek timber pile bridge 1,017 ft long, near Vallejo, Calif.; laminated timber deck replaced by 5-in. concrete slab with plywood bottom form left in place over stringers; new grade established by pile cut-off; unit costs bid.

WOODEN. Timber Bridges, H. I. Kaegi. *Civ. Eng.* (London), vol. 36, no. 408, June 1940, pp. 181–182, 184, and 186. Further examples of timber bridges in Europe and America, including suspension and arch types; construction of timber centering for concrete arch bridges. From Int. Rev. on Timber Utilization.

BUILDINGS

EARTHQUAKE RESISTANCE. Design of Earthquake Resistant Structures, J. J. Creskoff. *Bldg. Standards Monthly*, vol. 9, no. 7, July 1940, pp. 6–10. Lists of destructive earthquakes in United States since 1638; nature of earthquake shocks and their causes; principles of design of buildings and other structures to resist earthquakes.

EXHIBITION BUILDINGS, WOODEN. Experience in Maintenance of Large Timber Structures, J. J. Gould. *Eng. News-Rec.*, vol. 125, no. 7, Aug. 15, 1940, pp. 240–242. Results of frequent inspections of heavy timber construction in exposition buildings at San Francisco in relation to shrinkage, checking, and settlement; comparison of old and new joint types emphasizing advantages of ring connectors for timber trusses; performance of plywood and nailed structures.

CITY AND REGIONAL PLANNING

COUNTY PLANNING. Planning of County, C. Haddon. *Instn. Mun. & County Engrs.—J.*, vol. 66, no. 27, June 18, 1940, pp. 797–809, (discussion) 809–811. Outline of legal and administrative procedure in development of British county, with special reference to County of Lanark, in Scotland.

EXPRESSWAYS AND PARKWAYS. Sodium-Lighted Shoestrong Park Encircling New York, F. H. LaGuardia. *Am. City*, vol. 55, no. 8, Aug. 1940, pp. 103, 105, and 107. Development and features of greater New York sodium lighted 34.9-mile toll-free Belt Parkway opened on June 29, 1940; costs.

REPLANNING CITIES. Replanning Our Cities for Living, E. Goble. *Eng. News-Rec.*, vol. 125 no. 7, Aug. 15, 1940, pp. 231–233. Views of editor of National Real Estate Journal, Chicago, on stabilization of populations in American cities, various factors involved and consequences, traffic and transportation, downtown districts, slum clearance, and zoning.

CONCRETE

CONCRETE. Concrete Technology, M. N. Clair. *Boston Soc. Civ. Engrs.—J.*, vol. 27, no. 3, July 1940, pp. 183–206. Historical review of development of concrete technology, including specifications for cement and concrete, since 1862.

CONSTRUCTION, PRE-STRESSING. Recent Developments of Pre-Stressed Concrete Construction with Resulting Economy in Use of Steel, T. J. Gueritte and K. W. Mautner. *Structural Engr.*, vol. 18, no. 7, July 1940, pp. 626–642. Review of recent progress in development of prestressed concrete construction, with special reference to construction of small diameter shafts subjected to very high water heads, bridge girders, cable anchorages, etc.

CONSTRUCTION, VACUUM PROCESS. Vacuum-Processed Concrete. *Power & Works Engr.*, vol. 35, no. 405, Mar. 1940, p. 65. Vacuum process extracts surplus water from concrete after mix has been placed; construction process outlined.

CULVERTS. Jacks Push Culvert Into Place Under Railroad. *Construction Methods*, vol. 22, no. 7, July 1940, pp. 61 and 102. Description of jacking methods which made it possible for Missouri Pacific Railroad to replace in 105 min old two-panel timber trestle with new double 4- by 5-ft pre-cast concrete box culvert 22 ft long, at Gold Creek, Ark.

EXPANSION JOINTS. Oregon Plans Expansion Joint Study, C. B. McCullough. *Eng. News-Rec.*, vol. 125, no. 5, Aug. 1, 1940, pp. 168–169. Experiments on section of concrete paving near

A SPADE is one of the oldest tools known to man and still very handy when it comes to leveling off the bottom of a trench. But trench hoes and bulldozers have largely displaced the spade in the construction of cast iron pipe lines. Cast iron pipe is likewise one of the oldest materials for underground mains. Yet, in three centuries, no other type of pipe has usurped its place as the *standard* material for underground mains. Super-de Lavaud *chill-free* centrifugally cast iron pipe is the same standard material produced by improved and carefully controlled casting methods.

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Oregon state capital, involving five types of expansion joints; rating relative effectiveness of load transference in such joints; comparing effect of expansion joint spacings ranging from 30 to 495 ft.

FLOORS. Pre-Cast Concrete Floor Units Find Market in All Residential Building Types. *Concrete*, vol. 48, no. 7, July 1940, pp. 14 and 21. Special pre-cast concrete floor construction units, known as Flexicore units, bring fireproof floor construction to homes in all price ranges; method of manufacture described.

FORMS. Wood Panel Forms for Building Concrete Dams—II, H. P. Maxton. *Construction Methods*, vol. 22, no. 7, July 1940, pp. 45–47, 87–88, 90, 92–94, and 96. Second of series of articles dealing with form design, manufacture, handling and cost-keeping methods; typical designs of wood panel forms for Tennessee Valley Authority; cantilever forms; double vs. single panels; pipe struts; details of Hiwassee Dam panels; weights of wood panel forms; tests on wickets and tierods; form accessories; form design recommendations.

HANDLING. How Cement Pumping Helped Set Concreting Record. *Western Construction News*, vol. 15, no. 8, Aug. 1940, pp. 268–269. Description of cement-handling facilities at Grand Coulee Dam, including eleven 5,200-bbl storage silos, two blending silos, compressor equipment providing 13,000 cu ft per min, and pumps for unloading, blending, and transporting cement, for more than one mile, to concrete mixing plant at dam site.

REINFORCEMENT, GLASS. Glass Reinforcement for Concrete. *Engineer*, vol. 170, no. 4410, July 19, 1940, p. 478. System developed by A. W. Soden and J. A. Lincoln, by which glass strips are used in place of steel rods for reinforcement of concrete; reinforcement takes form of strips $^5/_{16}$ in. thick with depth equal to one-half that of beam to be reinforced; though in straight forward bending, glass reinforcement compares satisfactorily with steel, it will not stand up to as high impact load; inventors had in mind saving of steel in construction of air raid shelters.

REINFORCEMENT, WELDING. Shear Reinforcing for Concrete Beams, D. M. McCain. *Steel*, vol. 107, no. 3, July 15, 1940, pp. 58–59 and 78–79. Diagonal bars welded to top and bottom steel in concrete beams eliminate lack of continuity, permit stress in shear steel to be predicted accurately, lower costs, and make beams stronger.

RETAINING WALLS. These Concrete Retaining Walls Embody Novel Features. *Ry. Age*, vol. 108, no. 8, Aug. 24, 1940, pp. 281–285. Description of Erie Railroad's project at Jersey City, N.J., in which 4-track timber frame trestle was replaced by earth embankment held between concrete retaining walls; latter, on cantilever type, are supported partly on old walls and partly on piles.

VIADUCTS. Traveler Speeds Arch Viaduct Forms, K. A. Sheppard. *Eng. News-Rec.*, vol. 125, no. 11, Sept., 12, 1940, pp. 334–336. Use of traveler to support forms and provide work platform for erection and stripping on recently completed half-mile link in approach system of George Washington Bridge, New York City; load of deck concrete was carried directly to footing by vertical timber supports of heavy traveler frame; cost about $1,000,000.

VIADUCTS, MAINTENANCE AND REPAIR. Traveling Scaffold Helps Repair Long Concrete Viaduct. *Construction Methods*, vol. 22, no. 8, Aug. 1940, pp. 46–48. Description of special traveling steel scaffold, providing working platform on under side of structure for cutting out and replacing disintegrated concrete, in making extensive repairs to North Hill multiple-arch concrete viaduct, 2,840 ft long, in Akron, Ohio; replacing deteriorated concrete; cutting out portions of slab and beams with air tools.

DAMS

CONCRETE GRAVITY, CALIFORNIA. How Friant Dam Is Being Built. *Eng. News-Rec.*, vol. 125, no. 5, Aug. 1, 1940, pp. 144–148. Report on layout, equipment, and methods being used in construction of Friant concrete gravity dam 325 ft high, 3,340 ft long, near Fresno, Calif.; economic handling of aggregate at gravel pit and plant; making and moving concrete; ice machines to prevent stoppage of concrete placing during hot weather; derricks for handling work.

CONCRETE GRAVITY, CALIFORNIA. Shasta Dam. Aggregate Production. *Western Construction News*, vol. 15, no. 8, Aug. 1940, pp. 276–279. Description of aggregate processing plant, having capacity of 1,500 tons per hour, erected at Redding, Calif., to produce aggregate for concrete work in Kennett division of Central Valley Project; source and character of aggregate; crushing over-size; coarse aggregate processing; sand processing; flow diagram indicating processing arrangements from pit to delivery on Redding-Shasta Dam conveyor; manufacturing sand; major equipment.

CONCRETE GRAVITY, TEXAS. Marshall Ford Dam Completion, Texas. *Eng. News-Rec.*, vol. 125, no. 7, Aug. 15, 1940, p. 246. Unit costs bid on $4,000,000 contract for completion of concrete section of Marshall Ford Dam and construction of embankments providing for concrete straight-gravity dam having maximum height of 270 ft and crest length of 2,623 ft.

CONCRETE GRAVITY, WASHINGTON. Grand Coulee Dam and Columbia Basin Reclamation Project, S. E. Hutton. *Mech. Eng.*, vol. 62, no. 9, Sept. 1940, pp. 651–660. Peculiarities of Columbia River; geological, geographical, climatic, and economic features of western third of United States; energy available at Grand Coulee Dam; powerhouses, turbines, penstocks and coaster gates, generators and transformers, grounding system, station-service units; features of dam; excavation; diversion of river; bedrock grouting; placing concrete; markets for power; irrigation project. Before Am. Soc. Mech. Engrs.

CONSTRUCTION, EQUIPMENT. New Type of Rock Spreader Puts Facing on Earth Dam. *Eng. News-Rec.*, vol. 125, no. 7, Aug. 15, 1940, p. 239. Features of novel rock spreader, designed and built at Hansen Dam, resembling large trailer with body that can be tilted, as in dump truck.

CONVEYORS, BELT. Belt Takes Aggregate to Shasta. *Eng. News-Rec.*, vol. 125, no. 3, July 18, 1940, pp. 102–104. Design and construction of 36-in. belt conveyor system, 9.6 miles long, consisting of 26 flights 850 to 3,240 ft long for transportation of 10,000,000 tons of concrete materials to be delivered to Shasta Dam; protection at road crossings; power for conveyor operation.

EARTH. Recreational Use of Forest Waters, C. A. Betts. *Eng. News-Rec.*, vol. 125, no. 9, Aug. 1940, pp. 297–299. Design characteristics of small earth-fill and rock-fill dams for development of recreational facilities of forests.

EARTH, CUT-OFFS. Caissons Play New Part in Design of Large Dam, C. M. Clark. *Water Works Eng.*, vol. 93, no. 19, Sept. 11, 1940, pp. 1144–1149. Construction of cut-off wall for Merriman rolled-fill dam of Delaware River water supply for New York City; method of lowering ground-water level and cut-off wall construction by sinking 20 caissons alternately, excavating from one while pumping from other; control of trench water; water yield from caissons; problems of compressed air; check on temperature; removal of material; special muck locks; method of sealing.

FOUNDATIONS. British Practice in Dam Foundations, W. L. Lowe-Brown. *Water & Water Eng.*, vol. 42, no. 528, Midsummer 1940, pp. 310–318. Review of British practice in design of foundations of dams; influence of site on design; foundations of masonry and concrete dams; foundations of earth dams; cut-off trenches and cut-off walls; consolidation of ground by grouting; stopping leaks; typical examples of grouting below cut-off walls. Before Instn. Water Engrs.

FLOOD CONTROL

SUGGESTED PROGRAM. Complete Flood Protection—Suggested Program, J. M. Nicol. *Western Construction News*, vol. 15, no. 8, Aug. 1940, pp. 281–282. General discussion of flood protection problems, suggesting building of adequate escape mounds and raised highways for use during record floods; financing program.

FLOW OF FLUIDS

FLUMES. Construction Design Chart LVI—Flow Over Parshall Measuring Flume, J. R. Griffith. *Western Construction News*, vol. 15, no. 8, Aug. 1940, p. 286. Construction of alignment chart for measuring flow of water with free-flow Parshall measuring flume.

FOUNDATIONS

BRIDGE PIERS. Compressed Air Methods Control Sinking of Four-Cylinder Caissons. *Construction Methods*, vol. 22, no. 8, Aug. 1940, pp. 58–59 and 79–80. Methods and equipment used in construction of $2,100,000 substructure of Potomac River bridge at Ludlow Ferry, Md., to float four-legged caissons of massive dimensions from submerged fabricating platform, 2 miles upstream, and to lower them accurately to position over clusters of steel foundation piles at depths up to 72 ft below mean low water; adaptation of diving bell to large multiple-cylinder caissons.

BRIDGE PIERS. Steel Pile Bridge Piers on Canadian National Railways. *Engineer*, vol. 170, no. 4409, July 12, 1940, pp. 20–23. New departure from standard practice consists in use of steel H-bearing piles, driven to unusually great depths, and used not only as bearing structure below ground, but also to form pier itself, steel piles in each group are braced together, all connections being welded; application to several bridges described and illustrated.

BRIDGE PIERS, CONSTRUCTION. Caissons Sunk in Deep Water for Mississippi Bridge Piers. *Construction Methods*, vol. 22, no. 7, July 1940, pp. 54–55, 102, and 104. Description of caissons of three different types used in constructing four main concrete piers to support new $2,500,000 bridge across Mississippi River, between Natchez, Miss., and Vidalia, La.

RETAINING WALLS, DESIGN. Earth Pressure on Wall of Varying Height, C. E. Sharp, Jr. *Eng. News-Rec.*, vol. 125, no. 5, Aug. 1, 1940, p. 165. Theoretical mathematical discussion of method of evaluating earth pressure on wall of varying height, giving entire pressure on wall and moment of this entire pressure about bottom of wall, thus obviating process of summing up several prisms and pyramids whose separate pressures and pressure arms must be calculated and added together.

SOILS. Soil Mechanics in Foundation Engineering, R. L. James. *Inst. Petroleum—J.*, vol. 26, no. 201, July 1940, pp. 365–374. Review of results of recent studies on soil mechanics; soil behavior; influence of grain shape and grain size; capillary forces; shrinkage; distribution of stresses below foundation; ratio of stress to settlement; application of soil mechanics to design and construction of roads.

HYDRAULIC ENGINEERING

HYDRAULIC LABORATORIES, ST. LOUIS, MO. Pocket Hydraulics Laboratory, W. L. Blankenburg. *Eng. News-Rec.*, vol. 125, no. 11, Sept. 12, 1940, pp. 337–339. Description of new compactly laid out hydraulic laboratory at Washington University, St. Louis, Mo.; pumping equipment, consisting of two small centrifugal units, connected with pipes, tanks and multi-port cone valves to secure many variations of flow conditions; friction pipe rack and measuring devices; flexible flume design; manometer connections.

HYDROLOGY AND METEOROLOGY

EARTHQUAKE RESISTANCE. Earthquakes and Structures, D. L. Thornton. *Civ. Eng.* (London), vol. 35, no. 408, June 1940, pp. 174–175. Analysis of stresses produced by earthquake shocks; principles of design of foundations and buildings to resist earthquake shocks. Before Royal Soc. Arts.

RESEARCH. Techniques of Hydrologic Research, H. S. Riesbol. *Agric. Eng.*, vol. 21, no. 7, July 1940, pp. 269–273. Critical review of techniques utilized in hydrologic research; effects of interception of precipitation; progress in measuring and predicting infiltration; relation of runoff to other hydrologic processes; run-off rate and volume characteristics. Bibliography. Before Am. Soc. Agric. Engrs.

TIDES, AUSTRALIA. Tides in Swan River Estuary, A. Bennett. *Instn. Engrs. Australia—J.*, vol. 12, no. 7, July 1940, pp. 195–198. Study of action of tides in estuary of Swan River, near Fremantle in western Australia; tidal ranges for Fremantle, Perth, and Guildford; times of tide; tidal current; mean and maximum water levels; effect of Swan River improvements.

VIRGINIA. Hydrology of Virginia, P. H. McGauhey and H. B. Snyder, Jr. *Va. Polytechnic Inst.—Eng. Experiment Station—Bul. No. 44*, vol. 33, no. 10, May 1940, 94 pp., supp. plates. Bulletin studies maximum recorded flood flows of Virginia streams; investigates one, two, three, and five-day rainfalls producing such floods, and studies relationship between these rainfalls and maximum recorded rainfalls.

INLAND WATERWAYS

RIVERS, IMPROVEMENT. Regulation of Upper Mississippi. *Engineering*, vol. 150, no. 3888, July 19, 1940, pp. 41–43, supp. plates. Article concerned with part lying between Missouri and Minneapolis, Minn., having length of 650 miles; scheme has involved construction of 25 dams with accompanying navigation locks.

IRRIGATION

CANALS, SIPHONS. Mass Production Methods for Building Siphons Along Coachella Canal. *Western Construction News*, vol. 15, no. 7, July 1940, pp 231–234. Outline of standardized procedure for step-by-step construction of 32 siphons on branch of All-American Canal being built by Bureau of Reclamation at contract cost of $2,279,000; dikes and drainage system; forms for warped sections.

CHINA. Water Requirements for Rice Irrigation. *Engineer*, vol. 170, no. 4411, July 26, 1940, pp. 56–57. In view of prospects for rice growing on large scale in China, investigations have been made as to water requirements or water duty for rice fields; studies covered both total amount of water required and its distribution throughout irrigation season.

SOIL EROSION. Transportation of Soil in Irrigation Furrows, C. A. Taylor. *Agric. Eng.*, vol. 21, no. 8, Aug. 1940, pp. 307–309. Compilation of available information on transportation velocities and soil movement in relation to design of furrow shapes and choice of grades in irrigation developments; application of result G. K. Gilbert's laboratory studies of transportation of debris by running water; competent mean velocities at which transportation begins for various sizes of aggregate.

SUPPLEMENTAL. Thirty Years of Supplemental Irrigation Studies. W. L. Powers. *Agric. Eng.*, vol. 21, no. 8, Aug. 1940, pp. 311–312. Review of practice of supplemental irrigation in western Oregon where annual rainfall is from 38 to 90 in., while rainfall for the three summer months is under two inches; advantages of supplemental irrigation; operating factors; water supply influences

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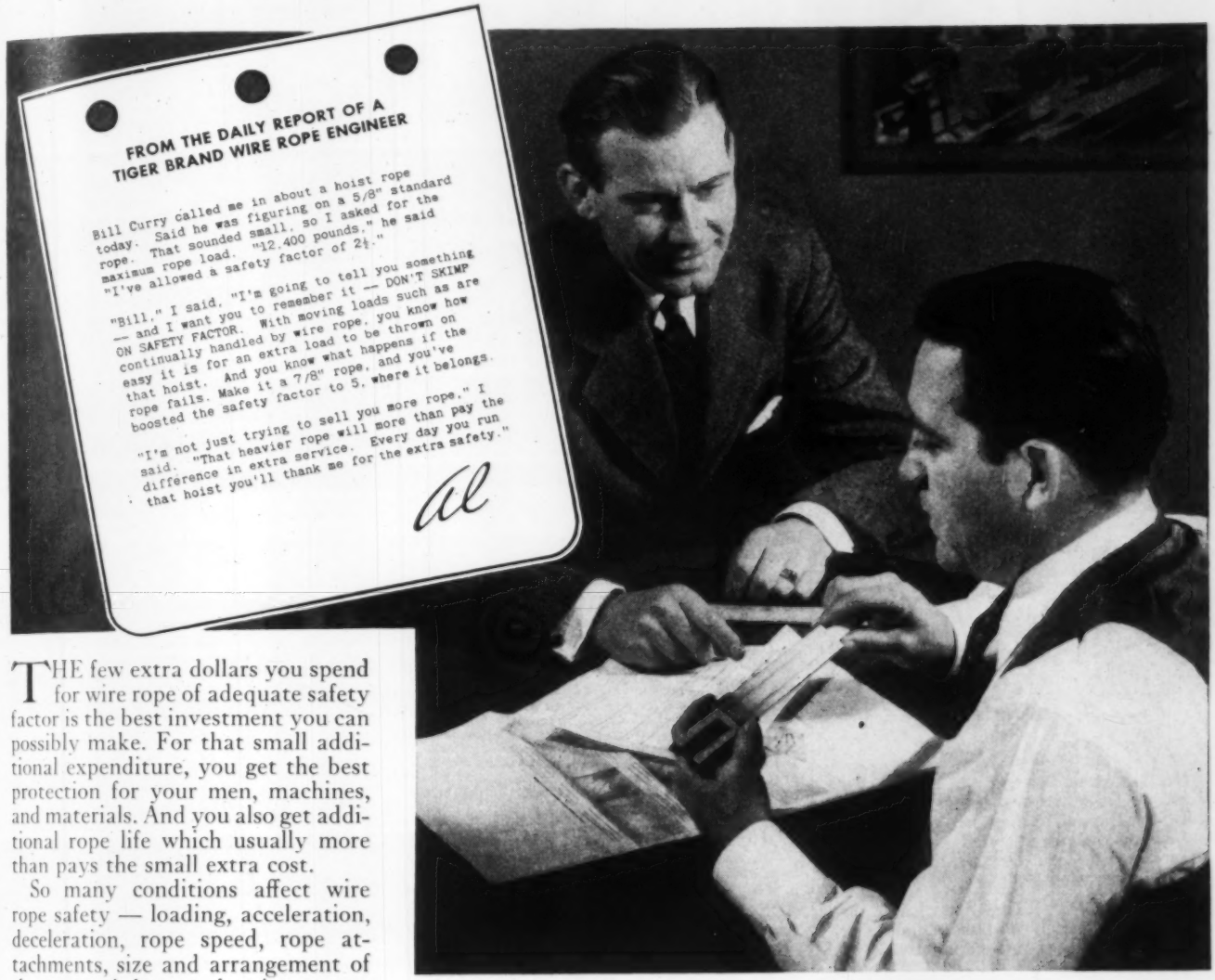
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LAND RECLAMATION AND DRAINAGE

AIRPORT RUNWAYS. CONSTRUCTION. Heavy Equipment Stabilizes 9-In. "Soil Concrete" Base for Washington Airport Runways. *Construction Methods*, vol. 22, no. 7, July 1940, pp. 42–44, 104–106, and 108–109. Layout of Washington national airport; equipment and methods used in construction of four runways 4,100 to 6,875 ft in length, 200 ft wide; details of single course construction and stabilization procedure; runway drainage; performance of mechanical construction equipment; soil mixture design.

ROADS AND STREETS. Importance of Subgrade Drainage in Road Construction, G. H. Beddoe. *Roads & Bridges*, vol. 78, no. 7, July 1940, pp. 11–14 and 57. Disintegrating effect of water on roads; principles of waterproofing and drainage of roads; Proctor compaction; need for impervious base courses.

VIADUCTS. Ground Water Presented Problem at This Street Subway. *Ry. Age*, vol. 109, no. 11, Sept. 14, 1940, pp. 366–368 and 373. Description of manner in which Norfolk & Western Railroad avoided difficulties during construction of street subway at Norfolk, Va., by use of extensive well-point system and installation of usual subsoil drainage system for completed structure.

MATERIALS TESTING

CONCRETE. Concrete Formula Based on 6,000 Tests, N. M. Finkbiner and G. W. Harra. *Eng. News-Rec.*, vol. 125, no. 11, Sept. 12, 1940, pp. 357–358. Discussion of Oregon highway department formula for predicting 28-day strength of concrete from results of tests of 7-day cylinders, relationship between 7-day and 28-day compressive strength of concrete cylinders made with four different brands of standard portland cement; prediction curve for 28-day strength of concrete.

ROAD MATERIALS. Degradation of Aggregates Under Rollers, T. E. Shelburne. *Roads & Bridges*, vol. 78, no. 7, July 1940, pp. 15 and 52. Results of Purdue University field tests of degradation effect of rolling of road aggregates on rigid and flexible bases. Before Am. Soc. Testing Matls.

TRUSSES, ALUMINUM. Tests of 28-Ft. Span Aluminium Alloy Trusses, R. L. Templin, E. C. Hartmann, and H. N. Hill. *Engineer*, vol. 170, no. 4411, July 26, 1940, pp. 61–62. Alloy used contains approximately 4% copper and fractional percentages of manganese and magnesium; structure on which tests were made consisted of two Pratt trusses, 5 ft deep and 28 ft long, divided into seven 4-ft panels.

ROADS AND STREETS

AIRPORT RUNWAYS. Airport Runways Surfaced with Slag-Asphalt on Drained Clay Subgrade. *Construction Methods*, vol. 22, no. 9, Sept. 1940, pp. 50–52, 109–110, 112, 114, and 116. Construction of four 150-ft runways, 3,600 to 3,850 ft long, on which plane can land from any direction, on plateau between Mahoning River and Lake Erie near Youngstown, Ohio; grading of site; drainage grid; sewage disposal; runway pavement; slag base construction; asphaltic concrete surface; concrete pavement.

AIRPORT RUNWAYS, SOIL-CEMENT. Soil-Cement Surfaces Camp Borden Adopts Low-Cost Light-Traffic Construction, J. M. Breen. *Roads & Bridges*, vol. 78, no. 6, June 1940, pp. 9–11 and 110. Principles of design and methods used in construction of 300,000 sq yd of soil-cement paving surfaces for widening and extending runways of airport at Camp Borden in Canada.

BITUMINOUS. Recent Patented Bituminous Pavements, G. W. Eckert. *Roads & Streets*, vol. 83, no. 8, Aug. 1940, pp. 44–48 and 50. Review of recent American patents on bituminous pavement construction; pavement construction involving stabilization of soils; bituminous paving compositions. Bibliography.

CONSTRUCTION. Compaction of Earthwork, E. L. Seidel. *Roads & Streets*, vol. 83, no. 8, Aug. 1940, pp. 54 and 56. Specifications, testing, and construction methods on two road sections in Kansas; Kansas standard compaction test; requirements for sheepsfoot rollers.

CONSTRUCTION. Gulf Coast Road Being Rebuilt as Dual Highway. *Eng. News-Rec.*, vol. 125, no. 11, Sept. 12, 1940, pp. 351–352. Reconstruction of 6-mile coast highway in Mississippi from Biloxi to Pass Christian; old road is to be repaved and used for west-bound traffic and new parallel road is being built back of seawall to serve east-bound traffic; concrete pavement is colored by use of emulsified carbon black to reduce glare.

CONSTRUCTION. Working Day and Night 25 Paving Outfits Place 2,000 Cu. Yd. per Hour in Pennsylvania Turnpike Slab. *Construction Methods*, vol. 22, no. 7, July 1940, pp. 62–65, 76, 78, 80, 82, and 84. Report on equipment and methods used in paving operations for completion of Pennsylvania Turnpike; performance and cost data.

EXPRESSWAYS, NEW YORK CITY. Riverfront Highway Squeezes Through Tight Places on Double-Deck Viaducts. *Construction Methods*, vol. 22, no. 7, July 1940, pp. 48–51, 96, 98–100, and 102. Construction of 2.3-mile section of East River Drive, in New York City, including double-deck viaducts and deep water piers; granite pier facing; floating concrete plant; benching rock bank; steel shell caissons.

EXPRESSWAYS, ONTARIO. Canada Builds 91-Mile Express Highway Involving 50 Bridges and 23 Grade Separations. *Construction Methods*, vol. 22, no. 9, Sept. 1940, pp. 48–49, 102, and 104. Description of Queen Elizabeth Way, providing 91-mile concrete paved arterial route of modern design linking Fort Erie, Niagara Falls, and Toronto at cost of $11,000,000; safety features.

WATER WORKS ENGINEERING

BURMA. Water Supply of Rangoon, Burma. *Engineer*, vol. 169, nos. 4403 and 4404, May 31, 1940, pp. 488–489 and 496, and June 7, pp. 508–509. Illustrated description; Gyobyu reservoir will have gross capacity of 17,000 million gal; main dam has flexible reinforced concrete core wall 350 ft long at top and 130 ft in height, divided into numerous concrete panels 25 ft wide by 10 ft high; details of overflow weir, diversion tunnel, and valve tower, pipe line 43½ miles long and coagulating basin.

DEPRECIATION. Depreciation Methods Condemned. *Water Works Eng.*, vol. 93, no. 19, Sept. 11, 1940, pp. 1201–1202. Comparative discussion of methods of figuring depreciation of water works, leading to conclusion that straight-line reduction is unfair to both consumer and system; compound interest plan advocated; depreciation of mains; depreciation and tuberculation.

DISTRIBUTION SYSTEMS. How to Increase Efficiency of Distribution System, L. A. Smith. *Water Works Eng.*, vol. 93, no. 17, Aug. 14, 1940, pp. 1018–1020. Review of experience of water works of Madison, Wis., in securing high ratio of water recorded on meters to total amount pumped; record of hydrant flow; detecting service leaks.

MANAGEMENT. How It Is Done at Chattanooga, N. N. Wolpert. *Water Works Eng.*, vol. 93, no. 16, July 31, 1940, pp. 968–971. Description of field and office maintenance methods of City Water Co., Chattanooga, Tenn.; water charges; servicing hydrants; fire alarm response; purchase of material; distribution records.

MOBILE LABORATORIES. Mobile Laboratories for Land and Water. *Eng. News-Rec.*, vol. 124, no. 25, June 20, 1940, pp. 66–68. Description of trailer field units and floating laboratory used in gathering stream pollution data in drainage area of Ohio River; total cost of mobile field laboratory including tow car, equipment, and six months' supplies is $3,671; operating experiences; converting army engineer quarter-boat Kiski to laboratory requirements.

SAN DIEGO, CALIF. San Diego Stores Hundred Billion Gallons of Water In Its Mountain Reservoirs, F. D. Pyle. *Western City*, vol. 16, no. 9, Sept. 1940, pp. 34–38. History of San Diego water works; statistical data on water consumption and water storage; chemical and bacterial analysis of San Diego water.

TANKS AND TOWERS, COLORADO. Pedestal Type Water Tank Serves Longmont, Colo. *Water Works Eng.*, vol. 93, no. 18, Aug. 28, 1940, p. 1085. Description of new 100,000-gal pedestal-type water tank recently erected in Longmont, Colo.; advantages claimed for pedestal water sphere at desirable design for elevated storage of water.

WAR-TIME PRECAUTIONS. Sabotage and Water Service. *Eng. News-Rec.*, vol. 125, no. 3, July 18, 1940, pp. 86–90. Staff report summarizing available information on methods of safeguarding water supply and water works against sabotage in war time, with special reference to treatment plant and distribution system precautions; federal and state aid.

WATERSHEDS, DEVELOPMENT. Real Estate Acquisitions for Metropolitan Boston's Water Supply in Swift River and Ware River Watersheds, J. A. Christenson. *New England Water Works Assn.—J.*, vol. 54, no. 2, June 1940, pp. 194–255. Methods of real estate purchases in Swift River and Ware River watersheds of Boston Water Supply system for sites of reservoirs and other works; organization, mapping, and taking methods; cemetery removals; forms used for real estate and cemetery work.

WELLS, SLUDGE PROTECTION. Sand Remover for Well Water Based on Centrifugal Flow, A. H. Jessup. *Water Works Eng.*, vol. 93, no. 19, Sept. 11, 1940, pp. 1156–1158 and 1204. Design of new wells for Oceanside, Calif., subject to flooding, featuring submersible deep well turbine pumps with well casing heads completely sealed-off; electric driving motor is located below pump bowls, and entire equipment is suspended many feet below surface; features of hydraulic sand extractor for removing sand and silt from water using principles of gravity and centrifugal force.

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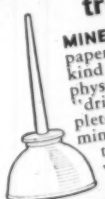

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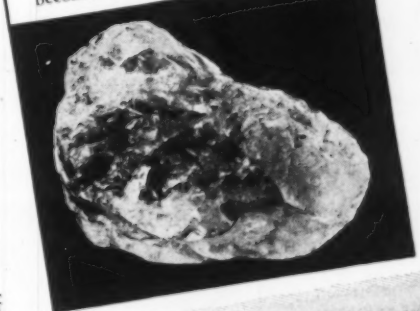

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RECENT BOOKS

New books of interest to Civil Engineers donated by the publishers to the Engineering Societies Library, or to the Society's Reading Room, will be found listed here. The notes regarding the books are taken from the books themselves, and this Society is not responsible for them.

AIR PHOTOGRAPHY APPLIED TO SURVEYING. By C. A. Hart. Longmans, Green and Co., New York, 1940. 365 pp., illus., tables, diagrs., charts, 9½ × 6 in., cloth $7.50.

This handsome volume bridges the gap between the specialist work and the popular book. Before outlining the various methods, elementary perspective and stereoscopy as applied to the subject are given. Then follows a description of the simple graphical methods of plotting, which have been very successful on medium scales, and later the corresponding simple method of producing contours.

Great Britain. Department of Scientific and Industrial Research. BUILDING RESEARCH. WARTIME BUILDING BULLETIN NO. 3. Type Designs for Small Huts. His Majesty's Stationery Office, London, 1940. 22 pp., diagrs., tables, 11 × 8½ in., paper. (Obtainable from British Library of Information, 50 Rockefeller Plaza, New York, 30 cents.)

This pamphlet discusses the war-time construction of one-story buildings to provide living quarters for soldiers, temporary offices, hospitals, etc., using the minimum of timber and steel. Attention is focused upon a hut to provide living accommodation for twenty-four men. A number of type designs are given and discussed critically.

CONSTRUCTION PLANNING AND PLANT. By A. J. Ackerman and C. H. Locher. McGraw-Hill Book Co., New York, 1940. 381 pp., illus., diagrs., charts, maps, tables, 9 × 6 in., cloth, $4.

Revised from a series of articles which appeared in *Construction Methods*, this book presents practical information on planning, management, and procedure for large construction jobs, particularly dams. Many types of construction machinery are fully described, and their efficient operation is explained. There are many diagrams, graphs and tables of useful data.

ELEMENTARY FLUID MECHANICS. By J. K. Vennard. John Wiley & Sons, New York, 1940. 351 pp., illus., diagrs., charts, tables, 9½ × 6 in., cloth, $3.50.

In order to present a more comprehensive idea of the basic physical principles of fluid mechanics the mathematical development has been carefully limited. The following topics are discussed: Physical properties, fluid statics, frictionless flow, similarity and dimensional analysis, frictional processes, pipe and open-channel flow, measuring apparatus, and flow about immersed objects. Brief bibliographies and groups of problems accompany each chapter.

ENGINES OF DEMOCRACY. By R. Burlingame. Charles Scribner's Sons, New York, 1940. 606 pp., illus., diagrs., maps, 9½ × 6 in., cloth, $3.75.

The history of modern America is viewed in the light of its technological advancement. As the developments in the fields of metallurgy, electrical communication, power, printing, highways, illumination, chemical synthesis, etc., are reviewed, their contribution to our present way of life is stressed. The book closes with a discussion of modern trends and of the social inventions that must follow the technical ones. There are a bibliography, a chronological list of events and inventions, and a very full index.

HANDBOOK OF ENGLISH IN ENGINEERING USAGE, 2 ed. By A. C. Howell. John Wiley & Sons, New York, 1940. 433 pp., illus., diagrs., charts, maps, tables, 8 × 5 in., cloth, $2.50.

Rules for proper English, covering word selection, sentence construction, style arrangement, punctuation, and grammar are clearly presented. Succeeding chapters discuss the composition of business letters, reports, and technical magazine articles. A great many examples from published material are included to demonstrate current practice.

INVENTORS AND ENGINEERS OF OLD NEW HAVEN (New Haven Tercentenary Publications). Edited by R. S. Kirby. New Haven Colony Historical Society, New Haven (Conn.), 1939. 111 pp., illus., diagrs., 10 × 6 in., cloth; apply to R. S. Kirby, Yale University.

This attractive little volume contains six lectures given under the auspices of the school of engineering at Yale University. The subjects are: Eli Whitney; early New Haven inventors; early Yale inventors; early Yale engineers; the formative years of New Haven's public utilities; the founding of the Sheffield Scientific School. The book contains a number of excellent portraits and will have permanent interest for students of engineering history.

MODERN THEORY OF SOLIDS. By F. Seitz. McGraw-Hill Book Co., New York and London, 1940. 698 pp., diagrs., charts, tables, 9½ × 6 in., cloth, $7.

This book surveys the theory of the properties of all types of crystalline solids, treating them from a common viewpoint. Besides dealing with the theory of metals, the book discusses the properties of salts and other insulators as well, showing the factors which account for differences and similarities among these materials.

PRACTICAL MECHANICS AND STRENGTH OF MATERIALS, 3 ed. By C. W. Leigh and J. F. Mangold. McGraw-Hill Book Co., New York, 1940. 498 pp., diagrs., charts, tables, 8 × 5 in., cloth, $3.

This volume presents those principles of mechanics and strength of materials that are believed to be essential for the practical man. In order to develop the two subjects as a whole, each chapter on strength of materials is preceded by those principles of mechanics necessary for its presentation. The many illustrative problems are new in this edition, and considerable material has been added.

Report of the Joint Committee on Standard Specifications for Concrete and Reinforced Concrete, submitting RECOMMENDED PRACTICE AND STANDARD SPECIFICATIONS FOR CONCRETE AND REINFORCED CONCRETE; affiliated committees of the American Concrete Institute, American Institute of Architects, American Railway Engineering Association, American Society of Civil Engineers, American Society for Testing Materials, Portland Cement Association. Submitted by American Concrete Institute, Detroit (Mich.), 1940. 140 pp., tables, charts, 9 × 6 in., paper, $1.50.

This report consists of three sections: (1) Recommended practice, which covers scope and definitions and details of design and construction; (2) standard specifications, covering materials, proportioning, mixing, etc., and forms and details of construction; and (3) appendixes containing information on the effect of various substances on concrete, on protective treatments, support moments, and curing, and a list of the specifications cited.

ROAD AND STREET CONSTRUCTION METHODS AND COSTS. By Halbert P. Gillette and John C. Black. Gillette Publishing Company, Chicago (330 South Wells Street), 1940. 607 pp., diagrs., charts, tables, 9 × 6 in., cloth, $6.

The purpose of the authors of this volume has been to assemble data on a wide variety of road and street problems in the most readily usable form. The volume is designed for use by contractors, engineers, and all highway officials who are concerned with bids, costs, and estimates.

SEWAGE TREATMENT. By K. Imhoff and G. M. Fair, with discussion of industrial wastes by E. W. Moore. John Wiley & Sons, New York, 1940. 370 pp., diagrs., charts, tables, 8½ × 5½ in., cloth, $3.

Modern practice in the design of sewage-treatment plants is discussed in a clear, concise manner, including the problem of industrial wastes. Diagrams, graphs, and tables of data are freely used; a section of sample calculations is included; and there is a broadly classified reading list. North American requirements and practices are referred to especially.

STRUCTURAL PLANNING AND DESIGN. By W. Glendinning. Apply to author, 5123 Bell Boulevard, Bayside, N.Y., 1940. 87 pp., diagrs., 11 × 8 in., paper, manifold, $2.10.

This book contains the solutions of problems on structural planning and design given to applicants for the license of Professional Engineer by the New York State Board of Examiners. Over 160 problems from the examinations from January 1933 to January 1940 are given. The problems are indexed by classes. The book will be of value to those preparing for examination.

WILEY TRIGONOMETRIC TABLES. John Wiley & Sons, New York, 1940. 81 pp., tables, 9 × 5½ in., cloth, 75 cents.

This collection aims to present, with accuracy and in clear type, the tables most used by students of trigonometry. The tables are: squares and square roots; constants with their common logarithms; natural logarithms of numbers; five-place logarithms of numbers; logarithms of functions; and four-place values of functions and radians.

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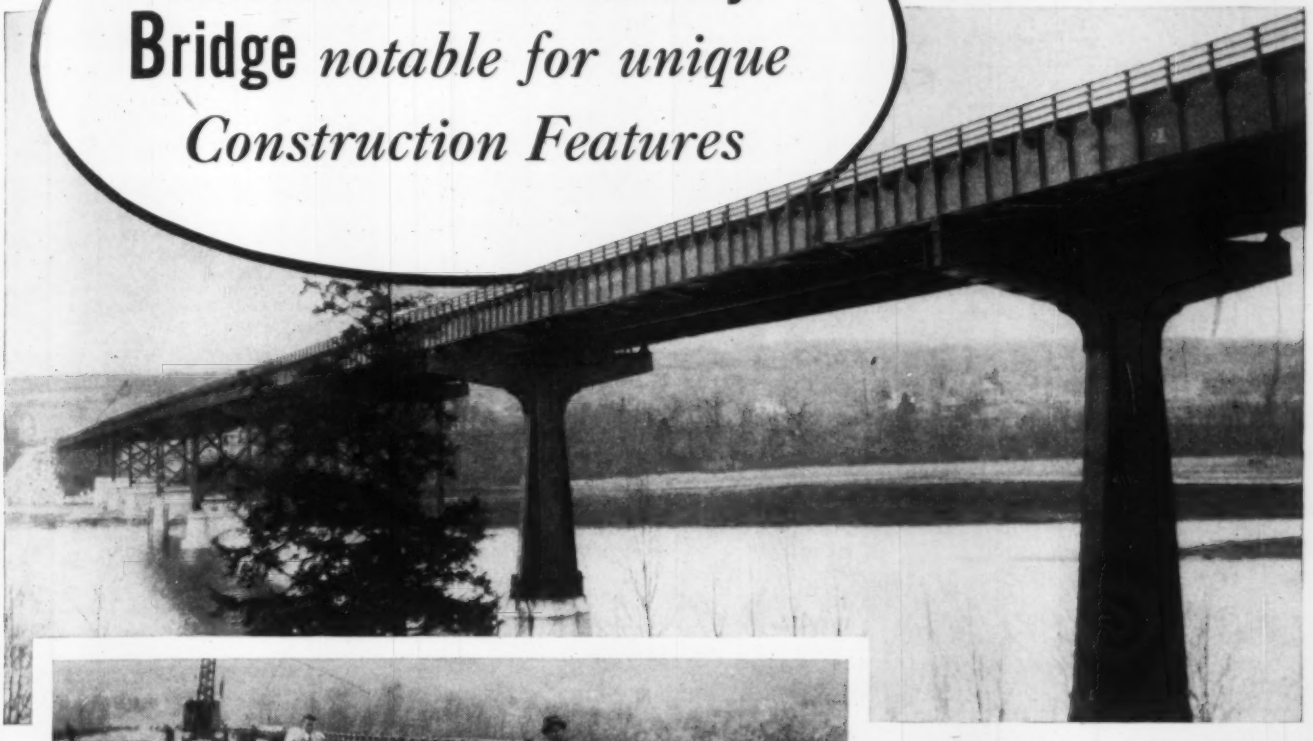

THREE CONTINUOUS PLATE GIRDER UNITS *256, 384 and 640 feet long—combined with a 544-ft. cantilever unit, comprise the Wilbur Cross Parkway Bridge. The cantilever unit (at the right of photo) is supported by two T-type bents of cellular construction, the stems of which are rigidly anchored to single cylindrical piers. Bridge piers are founded on H Bearing Piles and reinforced with U·S·S Reinforcing Bars furnished by Carnegie-Illinois Steel Corporation.*

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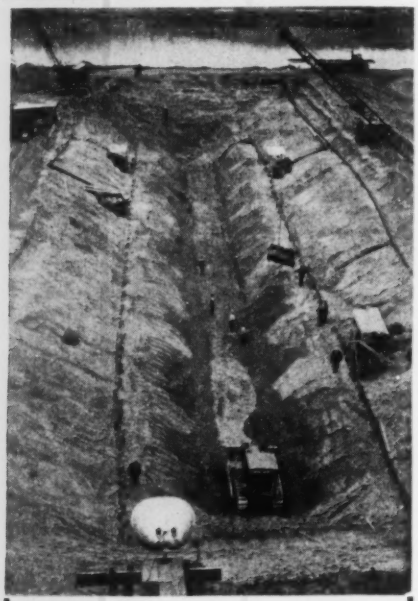

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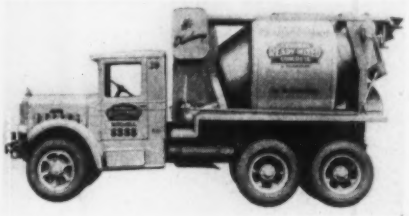

These new truck mixers are said to be of entirely new design and to have many revolutionary features, among them being rear charging, a new mixing principle, and a high discharging point for greater spouting range. The new mixing principle is claimed to make the drum self-cleaning while mixing, resulting in a faster and better mix. The Rex drum has only one opening for both charging and discharging; the big, wide charging hopper serves as a receiving hopper for aggregates while charging, a stationary throw-back blade while mixing, and at the same time affords visibility or sampling of the batch.

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The "Lincoln Weldirectory" is available on request. In addition to covering all types of welding procedure for various grades of steel and other metals, this bulletin contains a guide chart for selection of electrodes for various applications, a discussion of flat, convex and concave bends, a 2-page illustrated section giving pointers on the proper use of modern shielded arc welding, and a 10-page section on the subject of surfacing with arc welding, with detailed procedures.

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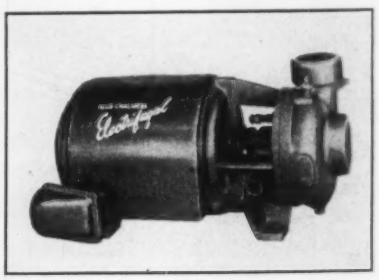

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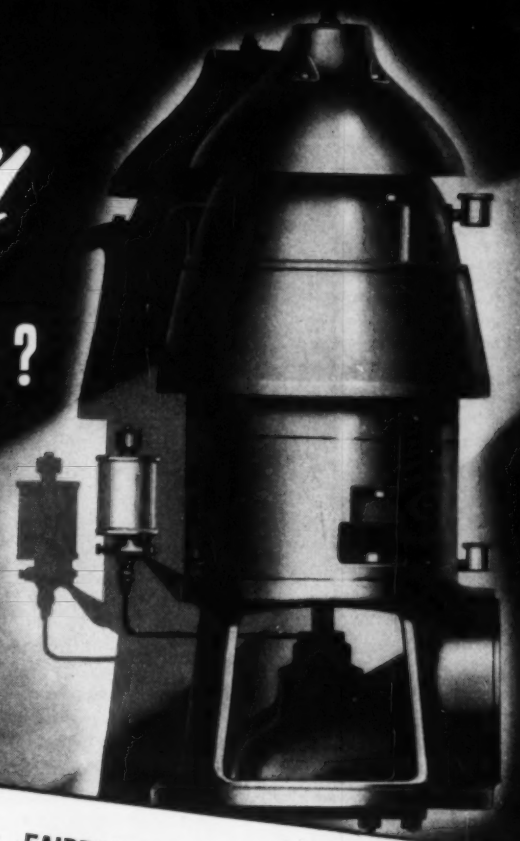

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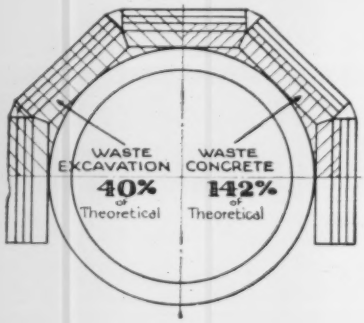

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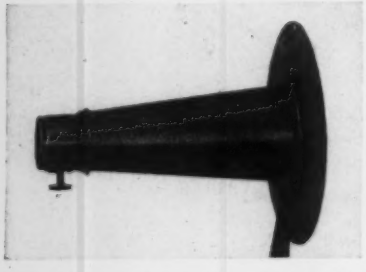
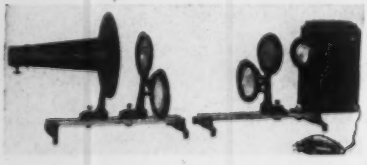


For either qualitative or quantitative photo-elastic analysis, perfection in the projection lens system is of major importance.



In our new model polariscopes of 4¼" & 6¼" clear aperture, the parallel beam is collected by a rear element and condensed through a three component lens of the Cooke system. In the new larger units (8¼" and 10" aperture) a four component lens of the Omnar system is used. In both cases, *the image is sharp throughout the field, free of aberration, astigmatism, and distortion.*

Literature of new model polariscope now available.

POLARIZING INSTRUMENT CO.
630 Fifth Ave., New York, N. Y.

Literature Available

AMMONIA FEEDERS—The where, why, and how of the use of aqua ammonia and Amm-O-Feeders is covered in Bulletin AMM. Proportioneers, Inc., 14 Codding St., Providence, R. I.

ARC WELDING—"Practical Lessons in Arc Welding," a pocket-size booklet described as a "Manual and Operator's Training Course," is sold at 50¢ by The Hobart Brothers Co., Troy, Ohio.

BELT REQUIREMENTS—The "V-Belt Data Book" of 170 pages is available upon request to The B. F. Goodrich Co., Akron, Ohio. It contains alphabetical listings of belt requirements for many types of equipment, numerical listings of belt sizes, and belt dimensions for both V and flat belts, as well as conversion listings.

BELTS—A useful drive data book for Condor Whipcord Endless Belts has been published by The Manhattan Rubber Mfg. Division of Passaic, N.J. It lists standard sizes of two styles of this endless flat belt which are carried in stock and are made to handle drives from 1/4 to 25 hp, also more than 1,500 drives of all types available with these standard stock belts.

CHEMICAL FEEDERS—Infilco Type MCO Chemical Solution Feeders, which volumetrically measure and feed clear chemical solutions in the treatment of water and sewage in chemical and industrial process work, are described in Bulletin 302, International Filter, Co., 325 W. 25th Place, Chicago, Ill.

CIRCUIT BREAKERS—A new Roller-Smith Catalog, No. 3630, illustrates and describes outdoor oil circuit breakers of 7500-volt rating and 50,000 KVA interrupting capacity. Roller-Smith Company, 1766 W. Market St., Bethlehem, Penna.

ELECTRICAL EQUIPMENT—A second 1940 edition, in 64 pages, of their "Quick Selector" catalog is announced by Westinghouse Electric & Manufacturing Co., East Pittsburgh, Penna. Electrical ratings, physical dimensions, and individual circuit diagrams for the various devices are included, along with accurate and up-to-the-minute price information for every item.

FLOCCULATION CONTROL—for the efficient clarification of water, waste liquid, or sewage is described, with illustrations and charts, in Bulletin 746. The Jeffrey Manufacturing Co., Columbus, Ohio

FLOODLIGHTING—Westinghouse Electric & Manufacturing Co., East Pittsburgh, Penna., have issued a two-page illustrated leaflet describing their new "Tufflite Concentrator" floodlighting unit designed for use with 300- or 400-watt type PS-40 lamps. Included are hints on application and a complete description of the rugged construction employed in this industrial floodlight.

FLOOR GRATINGS—A new catalog has been published by Wm. F. Klemp Co., 6601 S. Melvina Ave., Chicago, Ill. It describes diamond grating, steel stair treads, Hexteel heavy duty surface armor, and Klemp-Acme floorsteel, with tables of safe loads, and information on assembly and recommended fillers.

PAINT—The findings in more than 20,000 actual analyses of painting problems have been compiled in condensed form to make up the 120-page, pocket-size "Maintenance Painting Handbook" which has recently been published by the American-Marietta Co., 43 East Ohio St., Chicago, Ill., which will be distributed free of charge to industrialists and paint buyers.

ROLLER BEARINGS—An attractive, 36-page catalog on spherical roller bearings has been released by S K F Industries, Inc., Philadelphia, Penna. Illustrations of roller-bearing applications in various fields are followed by helpful information on bearing selection, time-saving computations, and drawings of various types of roller-bearing design.

SCRAPERS—Long haul, high-speed earth moving that extends profitable Carryall Scraper efficiency over truck haul distances is described, pictured graphically, and backed with job data, in a Tournapull folder issued by R. G. LeTourneau, Inc., Peoria, Ill.

SMALL MOTOR SELECTOR—An illustrated folding sheet containing all essential data needed to properly fit the right motor type to any job and covering the entire field of small motor application, is offered by Westinghouse Electric & Manufacturing Co., East Pittsburgh, Penna.

TRACTORS—Written in letter form and printed in typewriter type, Allis-Chalmers Manufacturing Co., Milwaukee, Wis., presents a 24-page, 2-color catalog of their new "HD 7" Diesel Crawler Tractor, describing its two-cycle Diesel power; balanced power and speed; bi-metallic clutches and brakes; new track release mechanism; and "Positive-Seal" truck wheels.

WATER CONDITIONING—The Permutit Co., 330 West 42nd St., New York, N.Y., has brought out Bulletin No. 2377, describing their "Mag-de-Sil" (Magnesia Silica Removal) Process for removing silica from high-pressure boiler feed water. It shows how the silica content of any water can be reduced to any value using moderate amounts of low cost reagents which do not add soluble by-products, and how this process can be adapted to either hot or cold lime soda treatment and applied to either new or existing equipment.

WATERPROOFING—Technical literature on this subject has just been published by Koppers Company, Tar and Chemical Division, Pittsburgh, Penna. "Membrane Waterproofing" (Form TB-3) tells when and how waterproofing should be applied, and describes the respective values of fabric and felt. "Dampproofing" (Form TB-4) describes how to dampproof poured concrete, concrete piles or slabs, foundation blocks, floors and sub-floors of superstructures. "Waterproofing and Dampproofing for Waterworks" (Form TB-5) and "Waterproofing and Dampproofing for Sewage Disposal Plants" (Form TB-2) cover these specific problems.

WELDING—Brazing and Soft Soldering of Monel, Nickel, and Inconel are gone into very thoroughly, with many illustrations and charts, in Technical Bulletin T-2, revised as of June 1940. The International Nickel Co., Inc., 67 Wall St., New York, N.Y.